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A Pattern for a Difficult Brass Casting.

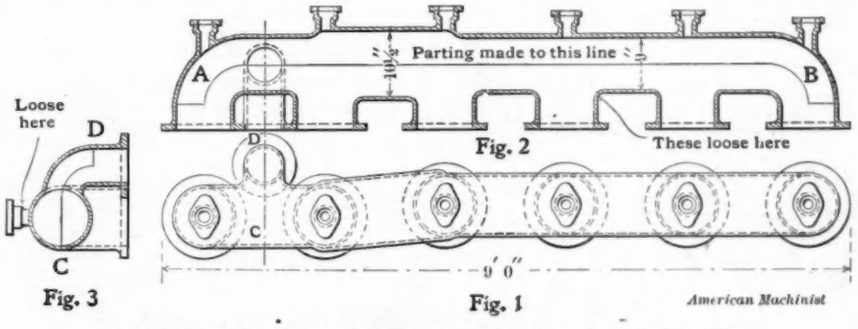
BY CHAS. H. ALLMOND.

I was lately called on to make the pattern for a very thin receiver pipe which was somewhat complicated, and as the pressure it had to stand was considerable, and the thickness could not be increased, I had to rack my brain some to devise a way that would reasonably insure an even thickness all over. As the castings made were a perfect success, and as I think the way of making it original, perhaps some of your readers would like to know how we did it. The sketch of the complete pipe herewith, I think, will need no explanation. From past experience with cores, I felt sure that they would have to be dismissed from our calculations. I next thought of a green sand core to be lifted out, but finally decided on the following way, and have been glad ever since that I did so:

I first turned up a form in halves, for the body of the pattern, to the size of the inside of the pipe; this, of course, having to be made in pieces, on account of the crook shown on Fig. 1. After fastening these together at the right angles, cutting to exact length between elbows, and putting seven-eighths of an inch on the face of each half, to give me something to go on, I took four thicknesses of 1-16-inch mahogany veneer and put them around this, gluing each course. Where the enlarged part came, I broke joints with each course and drew a piece of muslin around, bending each course to the form and gluing the muslin fast. After all were on, I took stout canvas and sewed around, leaving edges far enough apart on the back side so that I would have something to draw them with after warming. I then dampened the canvas and put the whole thing in the core oven until the glue began to run. As soon as it did, I took up all the slack I could get in the canvas, at the same time rubbing all the glue out of the joints that would come; then setting away to dry, and proceeding with the other half in the same way. As the short branches did not need to be split, I turned a piece solid for them, and long enough to make them all, wrapping the veneer clear around this, and cutting off in rings the right length, in the lathe, after it was dry, while still on the form. The elbows were built up in segments, out of Spanish cedar, and turned inside and out to ¼ inch thick. The flanges I also put up in segments and turned to fit rings of veneer for branches, gluing and pegging together. The stuffing boxes were turned out of solid stuff, with flanges turned to drop over core prints loosely.

After taking the canvas off my body pieces and smoothing them up, and scraping the joints where the swell came (where, it will be remembered, I had some muslin in the joints, making it a little thick there), and taking off the seven-eighths strip on the face of the form, and planing the pattern to the joint, I joined the elbows to the body piece by gluing and dovetailing pieces all around, about 1 inch apart. Next I fitted the short branches, gluing a batten fillet to body of pipe to hold the branches in place, and yet leaving them free to be drawn away from it. Next I cut holes through the body for the branches, and also cut three holes in the top half to ram up the core through, replacing the pieces cut out, and fastening them temporarily in place with three little clips that could be easily chipped off the castings. The stuffing boxes came next, and were simply fitted to the pattern and glued on. This, I think, finished the pattern.

The molding was done in a three-part wooden flask, and was begun by placing the cheek of the flask on the follow-board, with the bottom half of the pattern to the lines *A B* and *C D*. After ramming and tucking this, and making the parting to the line of the pattern, the core arbor was put in and the bottom half of the core rammed up; the top half of the pattern was then put on and the core finished through holes left for the purpose. Next the cope was put on and rammed up, taking out the stuffing box flanges one after the other and covering with flat cores. The flask was then rolled over, the drag was rammed and lifted off, and the short nozzles drawn out. The cheek was then lifted, the bottom half of the pattern drawn, cheek and drag were closed, the core was fastened down through the bottom board, and all rolled over again. Finally, the cope was lifted, the top half of pattern taken out and then closed again.

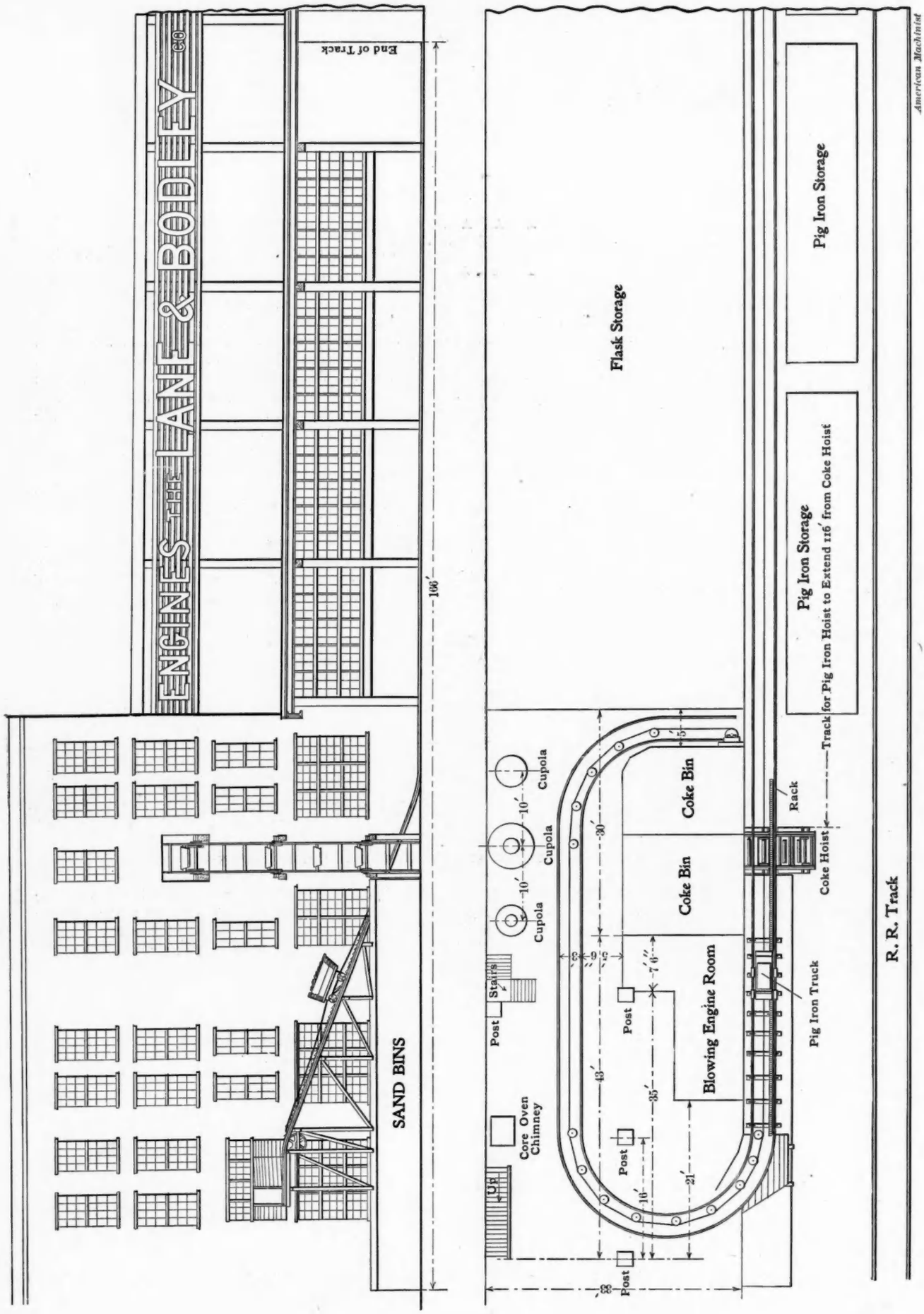


CASTING RECEIVER PIPE FOR TRIPLE EXPANSION ENGINE.

It will be seen from this that the core was never lifted from its place; half the pattern was always in when it was rolled over, and the core was fastened down through each opening in the bottom of the pipe. The stuffing boxes were, of course, dry sand cores, hung in the cope and just short enough so that they would not touch the green sand core when closing. It was poured by a runner the whole length of the flask, and gated with a pair of flat gates (ten in all) between each stuffing box on top of core.

There were four of these pipes cast in brass, and only one lost. They were tested to 150 pounds, and stood the test and passed a rigid inspection. I have heard of several failures to make such castings as these by some very good shops, and I hope this may help some fellow-craftsman out, should he be called on for something of this kind.

Seattle, Wash.



PIG IRON AND COKE HOIST.

Pig Iron and Coke Hoists for Foundry Use.

The handling of pig iron between the storage yard and the cupola is an operation to which very little attention has been paid, and which is to-day usually done in the manner of the fathers—by main strength and muscle. We illustrate herewith an apparatus in use at the works of the Lane & Bodley Company, of Cincinnati, O., which is the result of careful planning, and reduces the labor to a minimum.

The arrangement is shown in plan and elevation. The railroad siding by which the iron is delivered to the works, will be seen alongside and at a proper distance from the building. The iron is stored between track and building, each grade of iron having its own pile. Between these piles and the building is a second track, which by an incline rises to the level of the cupola-charging floor, when by a curve it enters the building and passes in front of the cupolas. A small car runs on this track, and by a hoisting rope is hauled up the incline and into the building, while a tail rope draws the empty car back to the lower level. This car is fitted with a pair of platform scales, by which the iron is weighed and the mixture determined in the process of loading. The car is simply brought to the pile containing the kind of iron wanted, when the desired quantity is loaded and weighed at the same time, and then hoisted to the charging floor and dumped. A rack will be seen fitted to the incline, with a pawl on the car to engage it—these being intended, of course, to insure safety.

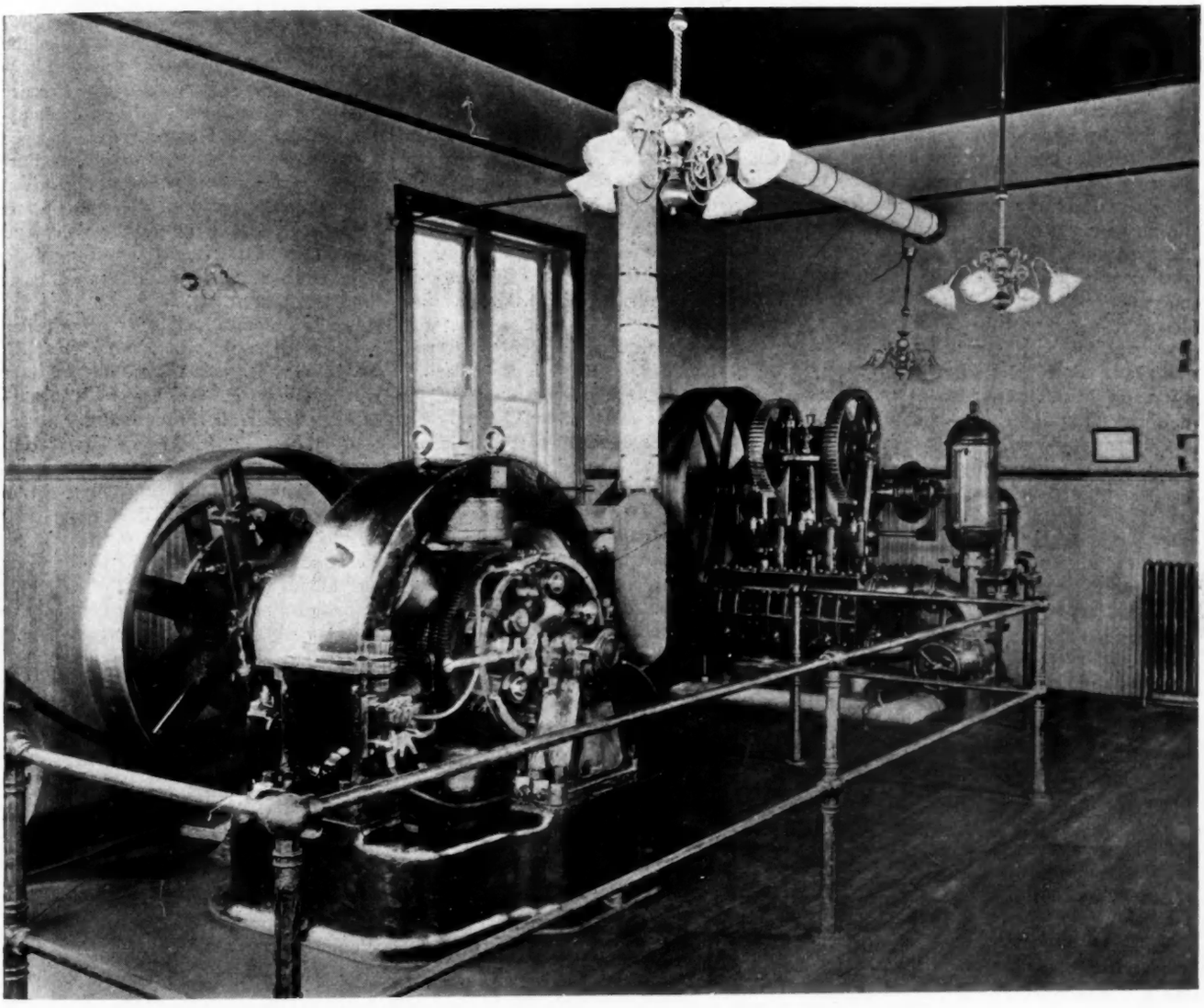
The bucket elevator coke hoist will also be seen arranged to take the coke from the point of delivery by the railroad, and deliver it to the coke bins on the level of the charging floor. The entire arrangement will be seen to cut down the number of handlings and labor involved to about the possible minimum, and in striking contrast with the methods usually employed.

Combined Pumping and Electric Lighting Plant for Small Towns.

We illustrate herewith a plant of machinery for the above-named purposes, of which a good many have been installed in the West. The machinery illustrated serves the town of Windom, Minn.

The purpose of the design is not only to economize in first cost, but to provide means of maintaining an approximation to uniform load, and thereby obviate the low efficiency of electric lighting plants due to the fluctuations in the load. This is accomplished by giving the same engine useful work to do in supplying the town with water during those portions of the day when the lighting load is light or absent. At the same time, the engine being in motion for supplying water, the small amount of current necessary for day lighting is supplied without the low efficiency due to the light day load, while no additonal attendance is required for such lighting service.

It will be seen that the water supply is



COMBINED PUMPING AND ELECTRIC LIGHTING PLANT.

furnished by a geared triplex pump, belted to the generator engine by means of the "ideal" method of power transmission. In this method of transmission the belt is applied to the lower side of the engine pulley only, where it is held by a tightening pulley, seen at the left of the picture, which is arranged for adjustment of the belt tension or for releasing it altogether. By this means the pump is thrown into or out of action, according as the lighting load will permit. In addition to this, the pump is arranged to be driven at either of two speeds, by which the power absorbed by it may be varied to suit the lighting load; full speed of the pump being used when there is little or no lighting load, the slow speed when the lighting load is heavier, and the pump being stopped during the evening hours of heaviest lighting load. This variation in the speed of pump is accomplished through the two gears seen mounted upon its crank shaft. These gears are of different sizes, and each has its own pinion upon the pulley shaft. These pinions are driven from the shaft by friction clutches, one of which will be seen at the end of the shaft. Both clutches are operated by the same hand lever, and without stopping the machinery. The equalization of the water supply and its continuance during the hours that pump is not running, are secured by the pump delivering into an elevated reservoir. It will be seen that the system not only provides in a large degree for saving the cost and attendance of separate plants for pumping and lighting, by using the same engine and boiler for both purposes during different portions of the day, but that means for maintaining a fairly uniform load are provided. It appears to possess a considerable field of usefulness for small towns.

The same general system is also employed with gasoline instead of steam engines.

The general design of the pump will be seen to be well adapted to give satisfactory service. It is of the three-throw type, giving a continuous movement to the water. The plungers have outside guides with the crosshead and connecting rod construction, obviating side thrust and wear upon the stuffing boxes, and giving better facilities for lubrication than the trunk plunger construction.

The plant was supplied by Henion & Hubbell, of 61-69 North Jefferson street, Chicago, to whom we are indebted for the photographic original of the engraving, and for the particulars incorporated in the above description.

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It is announced that steel is to be made in Alabama and that the Birmingham Rolling Mill Company has decided to convert its plant into a steel mill. There are already some smaller steel plants in Birmingham, but the new plant will be the first important one in that region.

Cultivation of the Inventive Capacity by the Solution of Constructive Problems.

BY LEICESTER ALLEN.

It is not my fault this time that the answers received to problem No. 8, issue of March 12, 1896, have been delayed. I prepared the article here presented soon after the date named. For reasons unknown to me, but presumably good, the publication has been deferred so long that I think I had better restate the problem, to save readers the trouble of looking it up. But before re-presenting the problem and giving solutions received, I think I ought to notice one or two echoes from Problem 6. With reference to his solution of that problem, presented in the issue of March 12th. Mr. C. J. Robertson writes that in the second alternative solution sent in by him, it will, of course, be noticed that the smallest bevels should be connected together as shown in Figs. 1 and 2, accompanying this explanation; otherwise, the turning of A would have no effect on B.

Fig. 1 is a section through the center line $N\,O$ of Fig. 2, which is an end-view of the large spur-gear stripped.

In Fig. 1, the shafts A and B are shown with their inner bearings (other bearings not shown), and marked "Bearings." A and B project inside of these bearings, and, as they are on one axial line, the large spur-gear R may run loose upon these ends, leaving an unused portion of the hub in the center through which the shaft S passes. The shaft S has a small bevel gear of, say, twenty teeth on one end meshing into the bevel gear on the shaft A, and a spur gear V of, say, twenty teeth on the other end; this shaft S being carried by bearings cast or bolted to sides of arms of the spur gear R on that side of these arms nearest to shaft A, and the bevel gear U dipping into the space M, Fig. 2, between the arms, while the spur gear V dips into the space P, Fig. 2.

On the side of the arms of the gear R, nearest to the shaft B, between P and Q, Fig. 2, is a lug in which a shaft W has its bearing, this shaft carrying a spur gear V' (with same number of teeth as V) on one end, meshing with V, and a bevel gear Y at the other end, meshing into the bevel gear on the shaft B, V' and Y dipping into spaces P and Q, respectively.

Now, as R carries S and W (with U, V, V' and Y upon them) all around together, they do not clash any more than if standing still, either with themselves or with the bevel wheels on A and B, since they clear (as shown in the figures) when standing still.

Mr. Robertson adds to this explanation the following remarks:

"If I were really going to make this thing, I should make an effort to have R, Fig. 1, symmetrical about the central plane of rotation of the center of the face of its teeth, and about the line $M\,Q$ in Fig. 2; and therefore the bevel gears on A and B would be symmetrical in appearance, and probably near enough alike to cast from one pattern, if too many of these hurdy-gurdies were not wanted.

"To this end I should try to have the two ends of the main boss of R, the ends of the shafts A and B, and the center lines of the shafts W and S, equidistant in Fig. 1, on each side of the face of the teeth in R, and so that the shaft W, could be run past B as S passes A; and then a lug would be back of the upper one shown in Fig. 2, similar to that sketched back of the lower one in Fig. 2. This would result in the same advantage of appearance and patterns as above pointed out with reference to the bevels on A and B. Also, when assembled, R would more readily balance than it would be as herewith sketched. Furthermore, the power would not be given onto W at one end of the single short bearing and taken off at the other end (as shown in the sketch), a thing I do only when I am sure that I must, as it does not wear so well.

"In the sketch, shaft S is much better conditioned to wear than is the shaft W. This also would cause R to have 'no right and left about it,' thus lessening the liability to error all through the construction.

"Also, in my fourth arrangement, shown in issue above named, one of the large bevel gears (say the driven one) should have 101 teeth, not 100, as printed, causing the center line of the pinion to be at a slight angle to the shaft A or B. It should also be remarked, I think, that the alternatives Nos. 2 and 4, which I presented, make A and B revolve oppositely.

"The third line from bottom on page 278 of the same issue should read:

'$\therefore$ 1 revolution $A = \frac{21}{101} \times \frac{100}{20}$ revs.'

"The fourth line from the top of the first column on page 279 should read:

'1 revolution $D = \frac{21}{101}$ revs. B;'

"The sentence beginning fifteenth line from the top of first column of page 279 should read:

'$\therefore$ rotation of C will require to drive B against its arrow $\frac{105}{101}\,a\,d\,b - \{\,a\,d\,b \pm b$ (1 or 0)$\,\}$ revs. B to length A.'

"The twenty-ninth line in the same column should read:

'$a\,c$ to $\frac{2\,a\,d\,b}{15} = c$ to $\frac{2\,d\,b}{15}$.'

"The thirty-first line, same column, should read:

'$a\,c$ to $\frac{4\,a\,d \pm 101}{30}\,b$.'

"I kept no copy of the alternative solutions, but I think it likely the omission in the second alternative was my own, and that the error of a tooth, and consequent slight misplacing of the pinion, occurred

in reproducing the figure, as the sketches sent were very rough and crude."

Mr. John T. Giddings, of Providence, R. I., writes further in relation to Mr. Colburn's solution of Problem No. 6, as follows:

"I had no idea of getting into a discussion concerning it, but having done so, I intend, if allowed, to hold up my end of the argument until proved to be wrong, which has not been done to my satisfaction so far.

"Mr. Colburn, in the issue of March 12th, says he thinks that I will find that my gearing (applied to his solution) 'would give a spiral of one turn in 36-10 inches.' This would be correct if there was but one tooth in the cutter; but as there are ten, the gear would give a spiral of one turn in 36 inches.

"I have looked over Mr. Colburn's original solution in the issue of September 13, 1894, and have read what he says about Mr. Fred. J. Miller's opinion, that the cam which actuates the backing off tool would need to be retarded or advanced as many revolutions as there are teeth in the cutter. And then Mr. Colburn says that he 'will not look at it from that standpoint in this case.' He then says, later in his solution, that 'in 3,600 revolutions of the spindle of lathe, the pencil or tool will have lost one revolution of the barrel, making but 3,599 circuits of points,' which in this case is correct. If Mr. Colburn can prove that in his solution one revolution of the splined shaft and cam would make a circuit of ten points, then I will admit that I am off the track. I have also read a description of a lathe for backing-off milling cutters, as built by J. E. Reinecker, of Chemnitz, Gablenz, Germany, in the "American Machinist" of August 8, 1895.

"From this description I surmise that the differential shaft would need to be retarded or advanced but once while the carriage is traveling the length of the spiral on the cutter, regardless of the number of teeth of the cutter.

"But the modifying effect of the change gears from the lead screw of the lathe takes place at one end of the differential shaft, while the change gears connecting the differential shaft with the splined shaft (to obtain the number of teeth on the cutter) are upon the other end. Supposing there are ten teeth in the center to be backed off; supposing, again, that the differential shaft makes the same number of revolutions as the lathe spindle; the change gear from differential shaft to splined shaft would be in a proportion of one to ten. Then, if the differential shaft was retarded or advanced once, it would retard or advance the splined shaft ten revolutions."

Problem No. 8, reprinted from the issue of March 12th, and referring to Fig. 3, is as follows:

"*S* and *S'* are two rotating shafts supported in box bearings. *D* is a spur-gear keyed to *S*, and *D'* is another spur-gear keyed to *S'*. These gears are alike in all respects. *E* and *E'* are two wheels carried also on the shafts *S* and *S'*. Their peripheries are smooth, and are brought as closely together as will permit their turning with, or on the shafts without rubbing together. Any mode of attaching these wheels *E* and *E'*, to the shafts which may be found compatible with the solution of the problem is permissible.

"It is required to supply mechanism wholly supported by the shafts *S*, *S'*, by which when *E* and *E'* are turned, each at same angular velocity, through an arc of 90 degrees, by the revolution of the shafts *S* and *S'*, *E* shall, while *E'* is revolving 10 degrees more at the previous velocity, move through an arc of 20 degrees, thus gaining ten degrees on *E*. This event is required to take place at each quadrant of the motion of *E'*, so that when *E'* has moved through an entire revolution, *E* has moved through an arc of 400 degrees.

"The only restriction to be observed is, that these movements may take place either at slow or at a considerable velocity; that is to say, any particular rate of movement within moderate limits must not affect materially the action described."

From solutions to this problem, I select, as a starter, an elegant one contributed by Mr. Walter Gribben, of Brooklyn, N. Y., whose name will be recognized as one appended to many interesting solutions and criticisms since the first of these problems appeared. Mr. Gribben explains the device, illustrated in Figs. 4 and 5, as follows:

"By the conditions of the problem, *D* and *D'* are keyed fast to their respective shafts (see Fig. 4). I have keyed the wheel *E'* fast to *S;* the large gear *A* is also keyed to *S*. *B* is a wide gear, running loosely on *S'* and meshing with *A*, and also with *C*, which is fast on the end of shaft *F;* one end of shaft *F* having a bear-

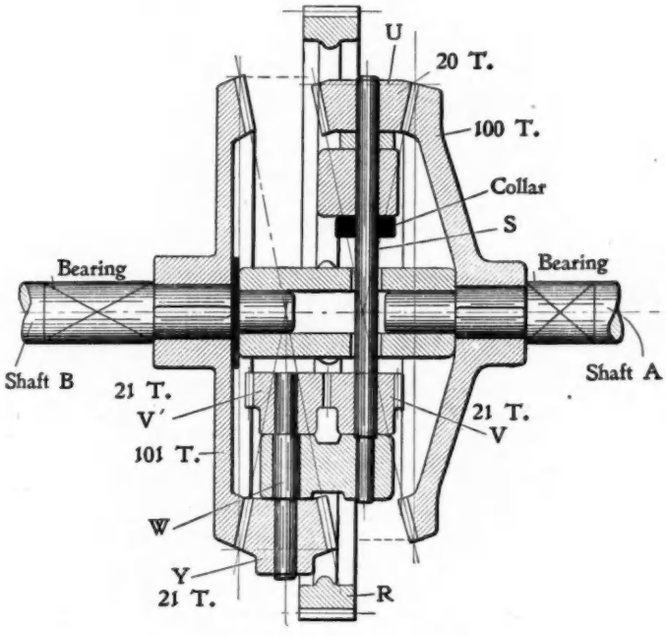

Fig. 1.
SECTION M-Q OF FIG. 2.

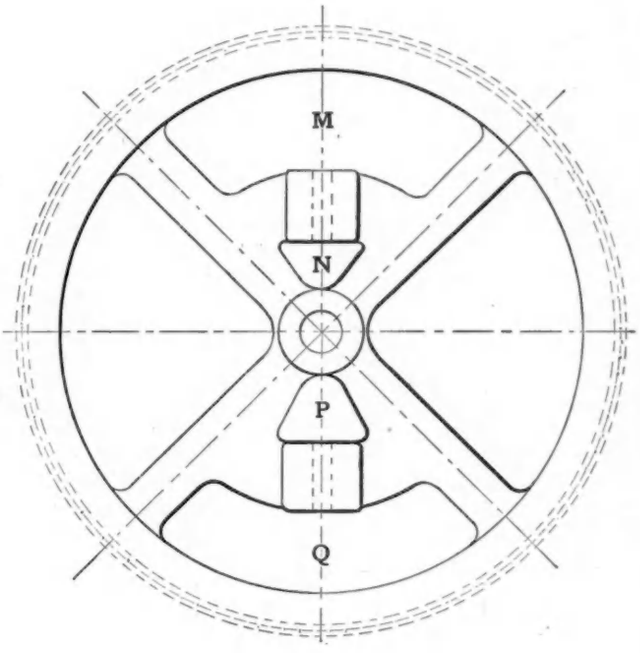

Fig. 2.
VIEW OF LARGE SPUR GEAR STRIPPED.

ing in web of gear D' and the other in end of arm L, which is pinned fast to shaft S'. K is a Geneva stop-wheel fastened to E, so that E and K may run loosely as one wheel on shaft S'. K is alternately operated by arm G, and locked by disk H, both G and H being fast on shaft F. A has five times as many teeth as B, while B and C are equal gears. Therefore, while D' makes one revolution, B will make five; or B will make four revolutions with respect to D', which will rotate shaft F in its bearings four times while shaft S' is making one rotation, or the shaft F will rotate in its bearings once while E' is making one-quarter turn. The stop-wheel K has thirty-six notches, so ten degrees would be included between consecutive notches. Therefore, on each rotation of shaft F and disk H, E and K will be accelerated ten degrees on shaft S'. The arc of action of the arm G, on stop-wheel K, extends through 40°, or one-ninth of a turn of H, as shown enlarged in Fig. 5. As one turn of H corresponds to 90° motion of E', then one-ninth turn of H will correspond to 10° motion of E', which is the period during which the acceleration is to take place; and as H rotates once for each 90° motion of E', the acceleration will be repeated at each quadrant of motion of E'.

"The number of accelerations for one rotation of E' is governed solely by the ratio between A and B, which may be

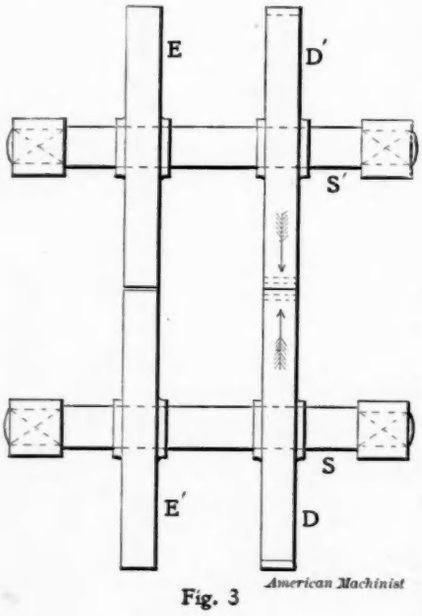

Fig. 3

represented by a fraction, the numerator of which is 1, and the denominator 1 plus the number of accelerations required in one turn of E'. In the given case, there are four accelerations required for 1 turn of E', so $\frac{1}{1+4} = \frac{1}{5}$ is the ratio of A and B. If there had been 3 accelerations required for one turn of E', then $\frac{1}{1+3} = \frac{1}{4}$ would be the ratio of A and B. In case we wanted 7 accelerations during 2 turns of E', then $\frac{2}{2+7} = \frac{2}{9}$ would be the ratio of A and B. If 1 acceleration was wanted for every 3 turns of E', then $\frac{3}{3+1} = \frac{3}{4}$ would be the ratio of A and B. If A and B were equal, then stop-wheel K would be inoperative; that is, we would have no accelerations during 1 turn of E', and $\frac{1}{1+0} = \frac{1}{1}$ would be the ratio of A and B. If B is made larger than A, then

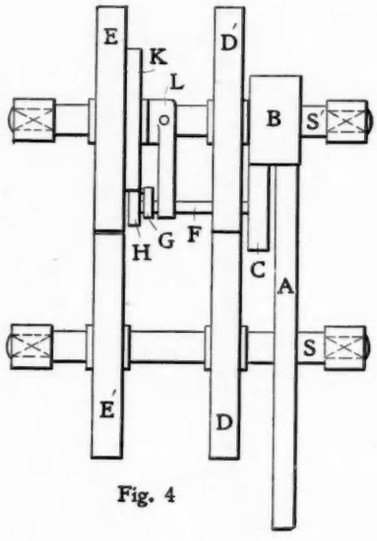

Fig. 4

we will get just as many retardations as we would otherwise get accelerations by employing a given ratio. In this case, B would really have to be two gears fastened together on one sleeve, and rotating loosely as one gear on shaft S', one part of B being equal to C, and the other part of whatever size the particular case called for.

"The amount of acceleration each time is governed solely by the number of notches in stop-wheel K, which is equal to 360° divided by the amount of acceleration required each time, and in the case given is $\frac{360}{10} = 36$ teeth. Had there been an acceleration of 15° required each time, then $\frac{360}{15} = 24$, the number of notches required in that case.

"The time during which the acceleration takes place is governed solely by the length of the arc of action of the arm G, and is equal to the number of accelerations during 1 turn of E', multiplied by the number of degrees motion of E' during which each acceleration is to last. In the case given, there are 4 accelerations during 1 turn of E', each one to last during 10° motion of E', so $4 \times 10° = 40°$, the arc of action of G. In case of 7 accelerations during 2 turns of E', each acceleration to last during 16° movement of E', then $\frac{7 \times 16°}{2} = 56°$ would be the arc of the action of G."

I doubt if there will be presented any more ingenious solution, or a more perspicuous explanation of this problem, than Mr. Gribben has thus furnished. I regard it as a model solution, both in manner and matter. The problem is by no means so easy as some previously given out, and I hardly expect such a harvest of solutions as were received for Problem No. 7.

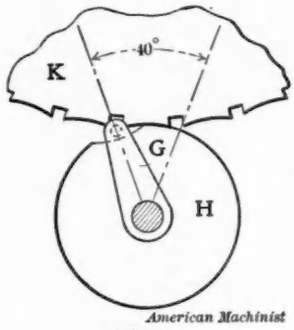

Fig. 5

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An English View of American Competition.

"We hesitate to express the figures which are given as the labor cost of producing rolled material at Duquesne and Homestead, feeling sure that our readers who understand such matters would hardly accept them. Suffice it to say that every process involved has been made so nearly automatic that skilled labor is dispensed with to an extent that is not known elsewhere, even in America. Hence, the Carnegie Company have at last decided that they are strong enough to attempt an invasion of European markets, as they have already invaded those of China, Japan, Russia and South America. We do not say that they will immediately make a serious impression on those markets, but we do say that they are strong enough to have a good try. They have, of course, to grapple with the difficulties of a 500-mile railway transport from Pittsburg to New York, and a 3,200-mile ocean freight from New York to Liverpool, and Vulcan might conceivably find the forging of the bolts of Jove an easier matter than a permanent wrestle with railway and steamship companies over such vast distances. Nevertheless, those who are familiar with the history of the iron trade will not forget that, less than a century and a half ago, we imported from our then American Colonies a large part of our iron supplies under much more difficult circumstances."—"Iron and Coal Trades Review." London.

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A royalty of $26,000 was paid by the British Government for each of the ships "Powerful" and "Terrible," to the owners of the Belleville boiler patents, which will stimulate other inventors to lose more than that.

Helping the Crank Over the Center.

We are familiar enough with the instincts and the mental habits of machinists in general to know that we need offer no apology in laying before them a device whose principal characteristics seem to be only novelty and ingenuity, and concerning the practicability and value of which we do not here wish to express an opinion. We can probably do our readers no greater service than to provoke them to think along mechanical lines, and the present device seems to be well calculated to be of some service in that direction.

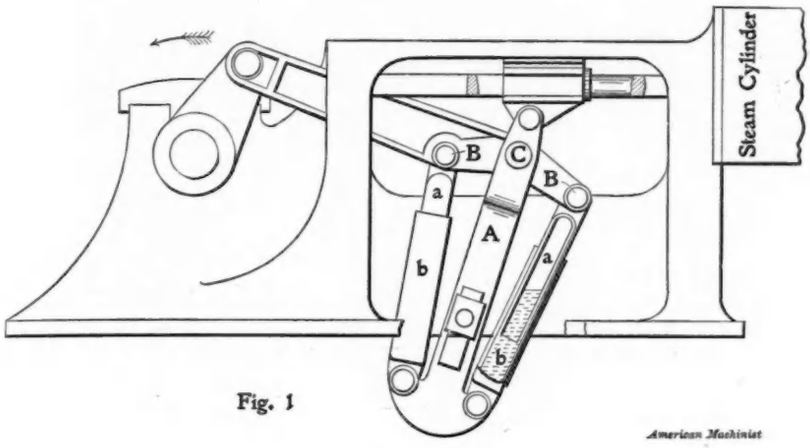

Fig. 1

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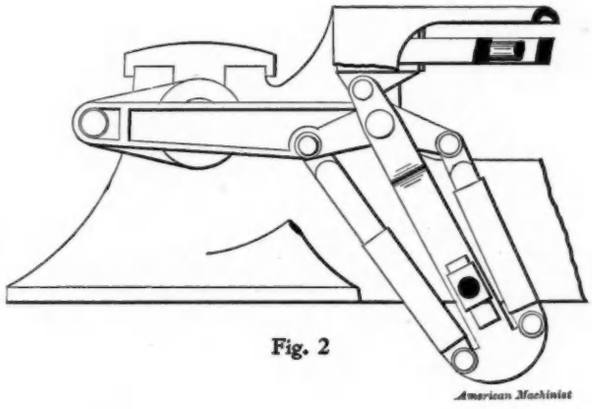


Fig. 2

American Machinist

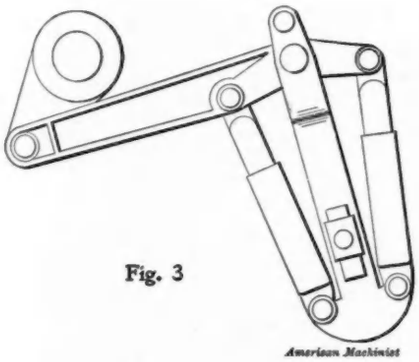


Fig. 3

American Machinist

The purpose of the device is indicated by the title above, and how the purpose is accomplished may be readily understood by reference to the accompanying sketches. Fig. 1 shows the principal parts of a horizontal steam engine, the crank of which runs "over," or in the direction indicated by the arrow. From the crosshead is suspended the vibrating arm *A*, which swings freely upon the pin at its upper end. This arm is slotted, as shown, toward its lower end, and in the slot is a sliding block which swings upon a pin fixed in the bed-plate of the engine. The arm is intended to be vertical when the crosshead is in mid-stroke. The connecting rod does not attach directly to the crosshead, but to the vibrating arm *A*, at a boss *C*, a little below the crosshead pin. The connecting rod has also the other two bosses *B B*, equidistant from *C*, and to these are attached two hollow plungers *a a*, open at their lower ends and working in cylinders *b b*, jointed to the vibrating arm *A* at each side of the main arm. The cylinders are partially filled with oil or other liquid, so that the lower ends of the pistons *a a* are always submerged. Stuffing boxes at the top of the cylinders must be provided, or some other means, to prevent the escape of the oil. The hollow pistons are to be filled with air or other elastic fluid under considerable pressure, and the elasticity of the air is depended upon to exert a driving force upon the crank when passing either dead center.

Referring now to Fig. 1, it will be seen that the two plungers *a a* stand at equal hights in their respective cylinders, and consequently, if the air is at the same pressure in each, both plungers will press upward equally, and in combination they will have no tendency to change the direction of the connecting rod, or to have any effect upon the turning of the crank. When, however, the crank has reached the outer center, as shown in Fig. 2, the relative upward pressure of the two pistons will have greatly changed. Here it will be seen that one plunger has risen in its cylinder, reducing the air pressure and decreasing the force of its thrust; while the other piston has been forced down, and the air pressure in it has been greatly increased, thus also increasing the thrust of that piston. In the position of the connecting rod, then, it is evident that the upward thrust of the high-pressure piston must cause a downward thrust upon the crank pin at the other end of the connecting rod, and so assist in the rotation of the crank. When the crank has reached the other center, as in Fig. 4, the other plunger has acquired the high pressure, and in turn its excess of thrust causes an upward pressure upon the crank pin, and so it also assists in turning the crank. In Figs. 1 and 3 the plungers have equal pressures, and consequently no rotative effect upon the crank; while their greatest effect is at or near the ends of the stroke, where it is required. It can at least be said of the device that it can be made to assist the crank over the center, and as it would be always operative, it would be practically impossible for the crank to stop on the center when the steam was shut off, and so, when the steam was turned on, the crank must always be in a position to start without help. In running, the object of the device is to equalize the turning effect upon the crank pin by giving out, near the centers, power which has been taken from the previous stroke.

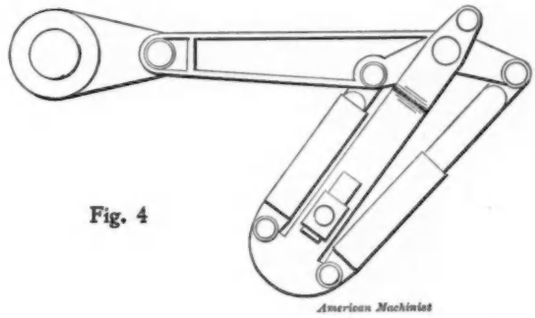


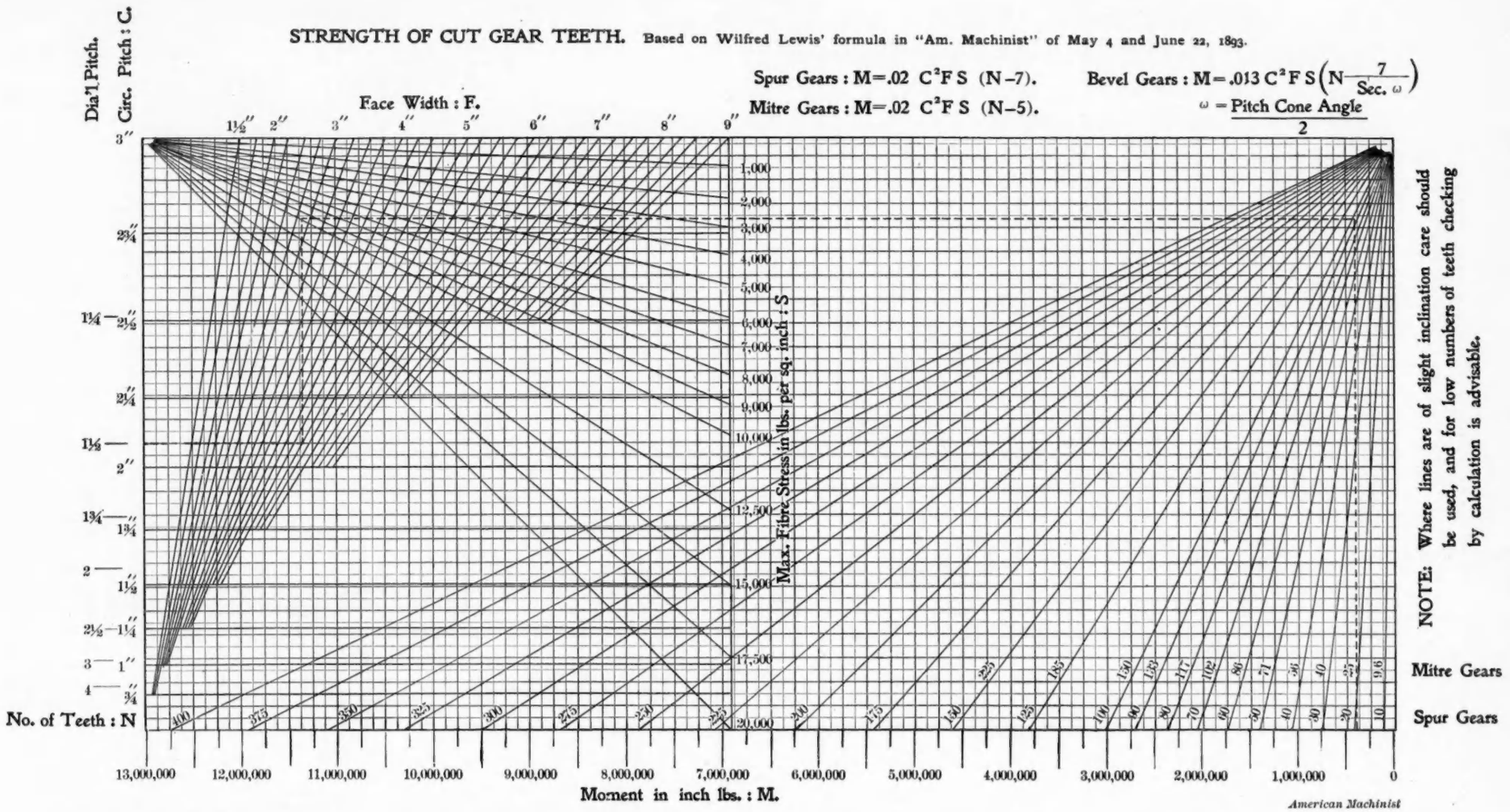
Fig. 4

American Machinist

The inventor of the device is John H. Fedeler, 456 West Twenty-second street, New York City.

▲ ▲ ▲

Plans are being laid for holding an international exhibition at Glasgow in 1901, and the prospects of an adequate guarantee fund are regarded as very favorable.


STRENGTH OF CUT GEAR TEETH. Based on Wilfred Lewis' formula in "Am. Machinist" of May 4 and June 22, 1893.
Spur Gears : M=.02 C²F S (N-7).
Mitre Gears : M=.02 C²F S (N-5).
Bevel Gears : M=.013 C²F S (N-7/Sec. ω)
ω = Pitch Cone Angle / 2
Dia'l Pitch. Circ. Pitch : C.
Face Width : F.
1½" 2" 3" 4" 5" 6" 7" 8" 9"
3" 2¾" 1¼—2½" 2¼" 1½—2" 1¾—1¾" 2—1½" 2½—1¼" 3—1" 4—¾"
No. of Teeth : N
Max. Fibre Stress in lbs. per sq. inch : S
1,000 2,000 3,000 4,000 5,000 6,000 7,000 8,000 9,000 10,000 12,500 15,000 17,500 20,000
400 375 350 325 300 275 250 225 200 175 150 125 100 90 80 70 60 50 40 30 25 20 10
Mitre Gears
Spur Gears
13,000,000 12,000,000 11,000,000 10,000,000 9,000,000 8,000,000 7,000,000 6,000,000 5,000,000 4,000,000 3,000,000 2,000,000 1,000,000 0
Moment in inch lbs. : M.
American Machinist
NOTE: Where lines are of slight inclination care should be used, and for low numbers of teeth checking by calculation is advisable.

The Strength of Gear Teeth.

BY HENRY HESS.

It would seem that on this well-worn subject little remained to be said, and in truth this article has nothing especially new to offer; still, those who have occasionally to consider what load may be properly imposed on a gear tooth may find in the annexed diagram a more convenient solution than the usual mathematical one.

Of formulæ there are about as many extant as there are pocket-books published, and as there are writers on mechanical subjects; but all of these, with one exception, are radically at fault in that they do not take into consideration the fact that the width of the tooth section at the base varies with the number of teeth in the gear, being small for a pinion and much greater for a gear of many teeth or a rack; yet, formulæ are based on the assumption of a constant section of tooth.

Mr. Wilfred Lewis was the first to call attention to this and to construct a formula recognizing the variation of tooth shape with the number of teeth. His formula took the shape:

$$W = C F S \left(.124 - \frac{.888}{N} \right), \text{ in which}$$

W = the tooth load in pounds;
C = the circular pitch in inches;
F = the face width in inches;
S = the maximum fibre stress in pounds per square inch;
N = the number of teeth in the gear.

In this original form the formula is somewhat unwieldy to handle, as the known element is usually the static load-moment, so that the formula can be used only to test the correctness of an assumed pitch, etc. For this reason I have transformed it as follows:

Let M = the static load moment in inch pounds, then

$$W = \frac{M\ 2\ \pi}{N\ C};$$

substituting this in the above formula gives

$$\frac{M\,2\,\pi}{N\,C} = C\,F\,S\left(.124 - \frac{.888}{N}\right)$$

and this in turn reduces to

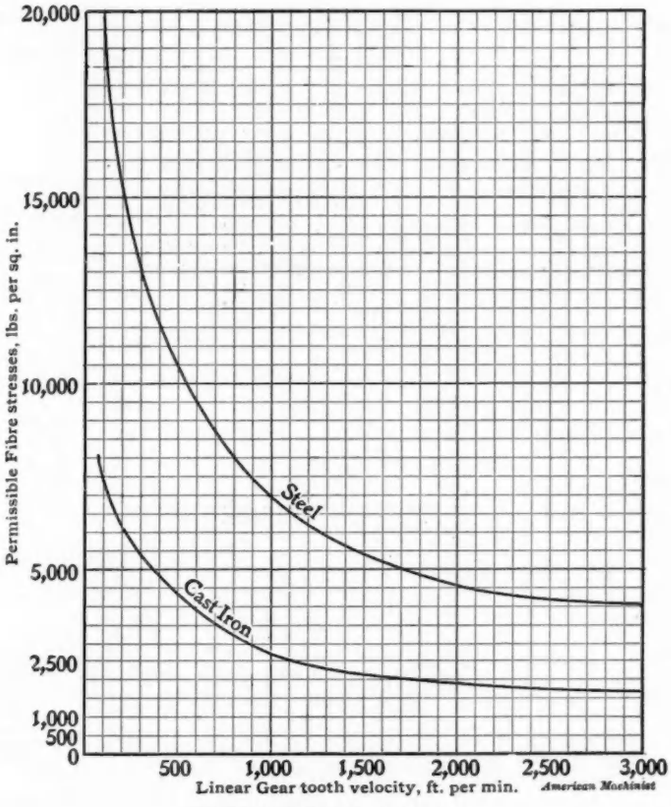
$$M = .02\,C^2\,F\,S\,(N - 7).$$

It should be borne in mind that these formulæ apply only to cut gears, or to such others as have a uniform bearing over their entire face width.

With the last formula as a basis, the diagram has been constructed. Turning now to this, there will be found at the left a vertical scale of circular pitches: this scale is not a uniformly increasing one, but is spaced in a ratio of squares, since the circular pitch appears in the formula as C^2. For convenience in using diametral pitch, a scale of diametral pitches has also been added. Starting from the lower left-hand corner is a bundle of diagonal lines representing various face widths and terminating in a uniformly increasing scale at the top. Another bundle of diagonals has its origin at the upper left-hand corner and stands for various fibre stresses; these lines terminate at the uniformly increasing vertical scale at the middle of the diagram. Diagonal lines terminating at the long bottom horizontal scale of moments have their origin at the upper right-hand corner; their scale also is uniformly increasing, so that the estimation of values lying between the lines is a very simple matter of direct proportioning by the eye.

There is drawn on the diagram a dotted line which shows the course traced between the various known quantities to find the one sought; the following rules give the proceeding more explicitly. A few trials, however, will show the simplicity of use of the diagram and lead to dispensing with a consultation of the rules.

To find the circular pitch C or the diametral pitch: Refer the known M vertically to the diagonal representing the number of teeth it is thought proper to use, trace the intersection horizontally to the fibre-stress diagonal, trace this intersection vertically to the face-width diagonal, and then tracing horizontally to the scale read the pitch.



FIBER STRESS FOR GEARS.

Correct up to about 1,200 ft. doubtful beyond; probably higher stresses may be used.

To find the number of teeth N: Refer the pitch horizontally to the face-width diagonal, refer the intersection vertically to the fibre-stress diagonal, refer this intersection horizontally across the tooth-number diagonals, and then the intersection with a vertical traced from the load-moment will pass through the diagonal representing the number of teeth to be used.

To find the face-width F: Trace the load-moment vertically to the tooth-number diagonal, trace this intersection horizontally to the fibre-stress diagonal, and from this intersection trace a vertical crossing the tooth-width diagonals. Through the intersection of this trace with one horizontally carried from the pitch will pass the diagonal giving the sought-for face width.

To find the load-moment M: From the pitch trace horizontally to the face-width diagonal; trace this intersection vertically to the fibre-stress diagonal; trace horizontally to the number of teeth diagonal, and this last intersection referred vertically downward will give the desired load moment.

To find fibre stress S: Refer the load moment vertically to the tooth-number diagonal, and trace the intersection horizontally across the fibre-stress diagonals. Now refer the pitch horizontally to the face diagonal, and from the intersection carry a vertical across the fibre-stress diagonals; the intersection of this vertical trace with the horizontal one already carried from the tooth-number diagonal will occur at a point through which passes that diagonal representing the fibre stress wanted.

On the diagram there is given in line with the formula for spur gears also one for bevel gears,

$$M = 0.013\,C^2\,F\,S\left(N - \frac{7}{\text{sec.}\,\omega}\right)$$

in which ω is one-half the pitch cone angle, while the rest of the notation is that given on the diagram scales and lines for the spur gear.

This formula is given in order to complete the subject, but is not to be solved by diagram without complicating the latter too much, owing to the large number of angles involving sec. ω that may occur. But the special case of the miter may be solved by the introduction of an extra scale of teeth given above, that for spur gears; the formula is

$$M = 0.013\;C^2\;F\;S\;(N - 5).$$

For both bevels and miters these formulæ are correct only when the face length is equal to one-third of the distance from the rear end of the tooth to the apex of the pitch cone; this length conforms to good practice; greater length will add but very little to the strength, while a lesser face gives a rather shorter tooth than is desirable. If it should, however, be unavoidable to use another proportion, then the general equation deduced from that worked out by Mr. Lewis may be used as follows:

$$M = .006\,C^2\,F\,S\left(N - \frac{7}{\text{sec.}\,\omega}\right)\left(\frac{D^3 - d^3}{D^2 - (D-d)}\right)$$

In order to avoid any possible misconception, it may be well to state that these formulæ and the diagram apply only to the at present standard practice in this country of cycloidal and 15-degree involute, 12-tooth base pinion outlines, and a tooth face and flank each equal to one divided by the diametrical pitch.

No experiments have been made from which final conclusions as to the fibre stresses most properly employed could be drawn, so that recourse must be had to the teachings of general practice. In gear teeth that are moving slowly, stresses may undoubtedly be allowed to occur that equal those permissible for loads at rest, but as the speed increases, the rapid alter-

nation of load and the shock of teeth impinging on one another makes necessary the use of greater factors of safety to cover our ignorance of the actual stresses.

The small diagram gives values for cast iron and steel that experience has shown to be safe; it is possible that for the higher speeds of from, say 1,200 feet per minute of tooth velocity, greater fibre stresses would be safe; but these velocities are of such rare occurrence that but little is known on the subject. For other materials similar curves may be drawn in, starting them for 100 feet per minute with a fibre stress about 0.6 of the elastic limit for materials having equal tension and compression values, and about 0.75 of the elastic tension limit for those materials having greater compression than tension values.

The editor has asked me to state my reasons for not basing the diagram on a known pitch diameter rather than on a known load moment. In my experience it has most frequently been the case that the diameter could be varied between more or less wide limits, while the load moment was a fixed quantity. If a pitch diameter is assumed, the tooth load has then to be found by an extra operation, by dividing the moment by the radius.

The formula for spur gears is

$$M = .02\ C^2\ F\ S\ (N - 7)$$

and $M = R\ W$.

When R is the pitch radius,

W is the load on the tooth;

then $$R = \frac{.02\ C^2\ F\ S\ (N-7)}{W}$$

Transposing gives

$$N = \frac{R\ W}{.02\ C^2\ F\ S} + 7$$

The equation for the moment is

$$M = .02\ C^2\ F\ S\ (N-7).$$

I much prefer doing my calculating with diagrams; the fewer lines these contain, the easier they are to read and the less the chance of error. Then, too, as I must frequently construct my own diagrams, it becomes of some importance to have to deal with the fewest variables possible, since every additional one adds in increasing ratio to the task of devising a simple arrangement involving the least possible crossing of lines. Of the two equations, that for N contains five variables, while that for M has only four. Even should the result found by first trial not give a suitable diameter, a second N and C can be very quickly obtained.

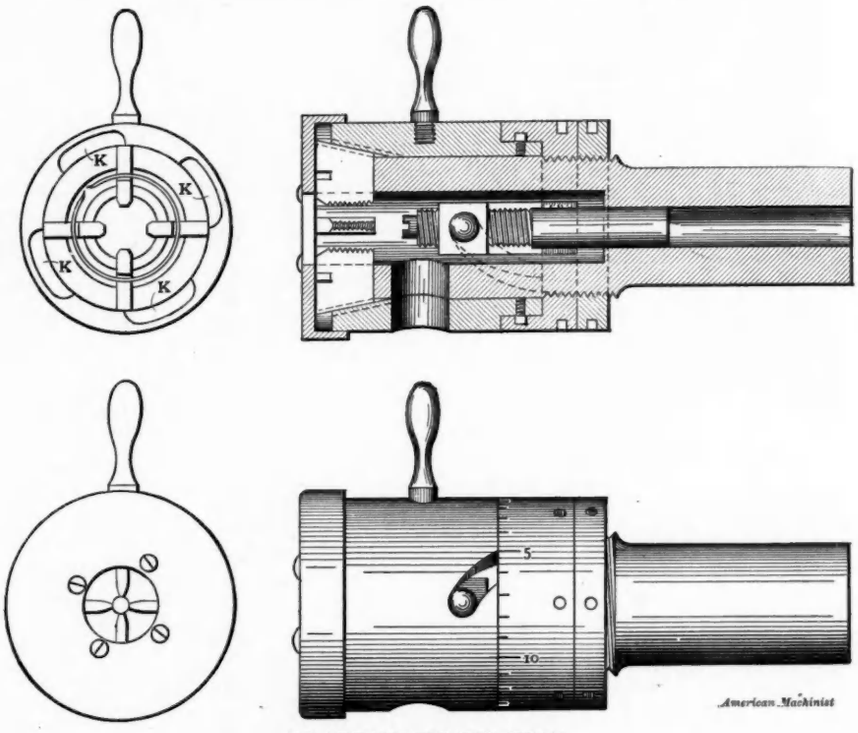
▲ ▲ ▲

Engineer-in-Chief Durston, of the British Navy, since his appointment, in 1889, has been responsible for more propelling machinery for warships than any other engineer living. In 1883 the indicated horse-power of British ships was 500,000; at present it is about 2,500,000, with 500,000 now building.

An Automatic and Adjustable Die Head.

We illustrate herewith a self-opening and adjustable die head for use upon turret head machines or hollow spindle lathes.

The central piece of the head runs entirely through it, the shank by which it is held being upon one end and the guide for the cutters being upon the other or front end. The cutters, of which there are four, slide in radial cross-slots and are held in place by a circular cap fitted over them and secured by four screws. Upon removing the cap, the cutters may be slipped out and others inserted as desired.



AN AUTOMATIC DIE HEAD.

In the front edge of each cutter is a groove into which drops a circular spring which is always in compression, tending to press the cutters outward. When cutting threads, the cutters are solidly backed against a conical surface in the outer shell, which has a limited rotary movement upon the head. A little turn of the shell, which occurs automatically, brings four pockets or recesses K opposite the ends of the cutters, and they fly outward enough to entirely free the piece being cut, and it may be withdrawn. The outer shell has two opposite helical slots in which play the ends of a small crosshead with a friction roller, filling the slot on each end. The crosshead passes through longitudinal slots in the body, and in the center of the crosshead there is an adjustable screw or stop which is set for the length of the thread to be cut. When the piece being cut strikes this stop, the crosshead moves backward, the outer shell revolves, the cutters fly out and the piece is released. The die is closed again, either by the handle or by a pin on the under side which comes against the slide when the turret revolves. The adjustment of the die for size is accomplished by the large graduated circular nut back of the shell. Turning this nut moves the entire shell backward or forward as required. The graduations upon the circular nut indicate thousandths of an inch.

The head may be used for either right-hand or left-hand threads. It is made in two sizes, No. 1 cutting from 3-16 inch to ⅜ inch, and No. 2 cutting from ⅜ inch to ⅞ inch, inclusive, by the Bunker Hill Manufacturing Company, 92 Washington street, Chicago, Ill.

The International Correspondence Schools.

We have received the circular of information of the International Correspondence Schools of Scranton, Pa., for 1897, and are glad to note the steady progress which this excellent institution is making. It now has a corps of 45 teachers, and students all over the world. The circular gives a full description of the courses of study and the methods followed. The fees are surprisingly small, and personal acquaintance with a number of students of the school has convinced us of the value of the instruction given.

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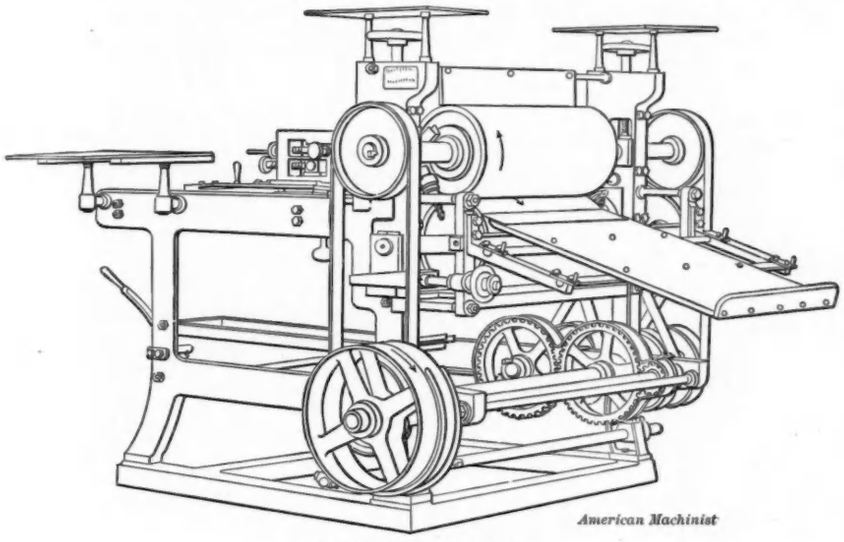
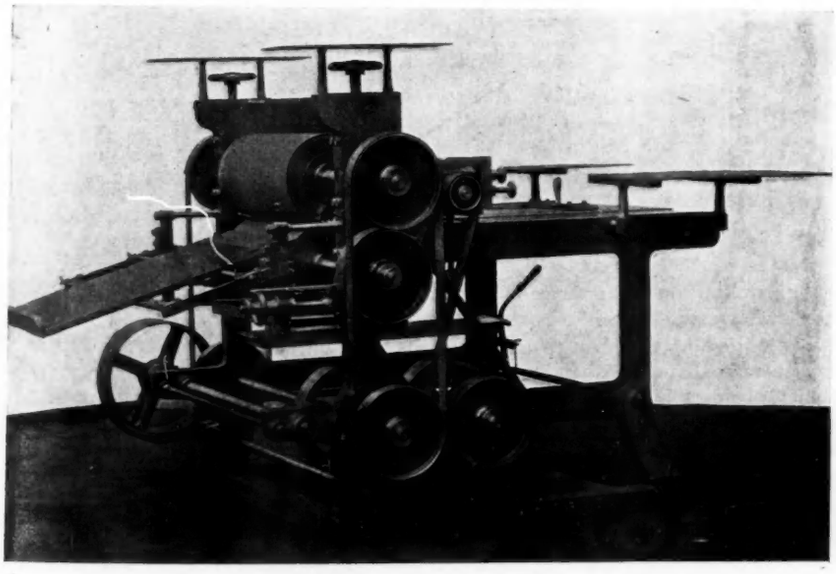
We are glad to note that there is some sign of life in the American Institute, for while there is life there is hope. Not all of the directorate were satisfied with the last "Exhibition of American Art and Industry." It is certain that none of the outsiders had any reason to be satisfied with it.

A Tin-Lacquering Machine.

The machine shown in half-tone and in outline perspective is "made in Germany" by Friedrich Heims & Co., Offenbach, Germany. The first machine, by the way, was sold to an English firm. It is for lacquering or varnishing sheets of tin (upon one side only), and its output for ten hours is 6,000 sheets. It has actually done 8,000 sheets of the largest size in a day.



LACQUERING MACHINE.



A LACQUERING MACHINE.

Ten or a dozen pasteboard "battens" are provided somewhat smaller each way than the sheets of tin. Each sheet is laid upon one of these battens and they are passed together through the rollers, the upper roller doing the lacquering, and as fast as the sheets are taken away the battens are handed back, the thin tables above the machine being employed in the transfer.

The surfaces of both the lacquering roller and of the "pushing" roller under are elastic, so that ruffled or creased plates may be lacquered with a uniform surface. The hand wheels under the delivery apron work horizontal screws, which, in turn, work wedges which adjust the hight of the pushing roller.

The distribution of the lacquer to the upper elastic roller is done by means of two steel rollers, one of which, driven by the small upper pulley, dips in a pan containing the lacquer, and the quantity delivered is determined by the adjustment of the two steel rollers in relation to the larger elastic one, which applies it to the tin surface. As the first steel roller constantly takes up more lacquer than is required, the surplus flows back to the pan and there is no waste, while the machine does the work more uniformly and much more rapidly than was possible before its introduction.

David Kirkaldy.

Mr. David Kirkaldy, the famous English engineer of tests, died on Monday, the 25th ult., at the age of 76 years. Mr. Kirkaldy started life as a draftsman, and while employed in the works of Robert Napier, in Glasgow, made a sectional drawing of the steamship "Persia," which was exhibited at the Royal Academy, and is said to have been the only mechanical drawing which ever received such a distinction. Later, Mr. Kirkaldy's attention was drawn to the importance of knowing just what could be depended upon with the different materials used in engineering constructions and this finally led to his having a machine constructed for the purpose of making such tests. This was the first machine of a class which has now become quite common, and without which modern engineering would be much less exact and scientific than is now the case. Mr. Kirkaldy was a man of strong convictions, and of sterling integrity. No one ever doubted the honesty of a report of tests of materials made in his laboratory, and his authority came to be unquestioned in his line. His firmly held opinions on matters connected with his profession led him into many controversies with others who eventually became connected with similar work, and, as is the case with nearly every pioneer, he made enemies; but no one ever failed to thoroughly respect him as a man of high ability and character, and few men ever lived who have done more to advance the science of engineering.

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Inspection of Steel Plates by the U. S. Navy!

An engineer was a short time ago walking through the Carnegie establishment, and noticed a sailor-looking man stamping steel plates with an inspector's stamp, and he was stamping every plate as it reached him, impartially. The engineer stepped up to the man and asked him if there were no rejected plates, and if they were all of them accepted. The man, who turned out to be a "sailmaker" in the United States Navy, remarked: "I don't know anything about that; I was sent here to stamp plates, and by G—— I'm going to stamp 'em."

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The exports of merchandise from the United States for December, 1896, amounted to $117,227,102 against $92,529,117 for December, 1895. For the year 1896 the exports were $1,005,878,417, and for 1895 they were $824,860,136. In December, 1896, the excess of exports over imports was $59,271,093, and in December, 1895, the excess was $30,328,070. For the twelve months ending December 31, 1896, the excess of exports over imports was $325,322,184, while for the year 1895 the excess of exports was only $23,190,789.

Letters from Practical Men.

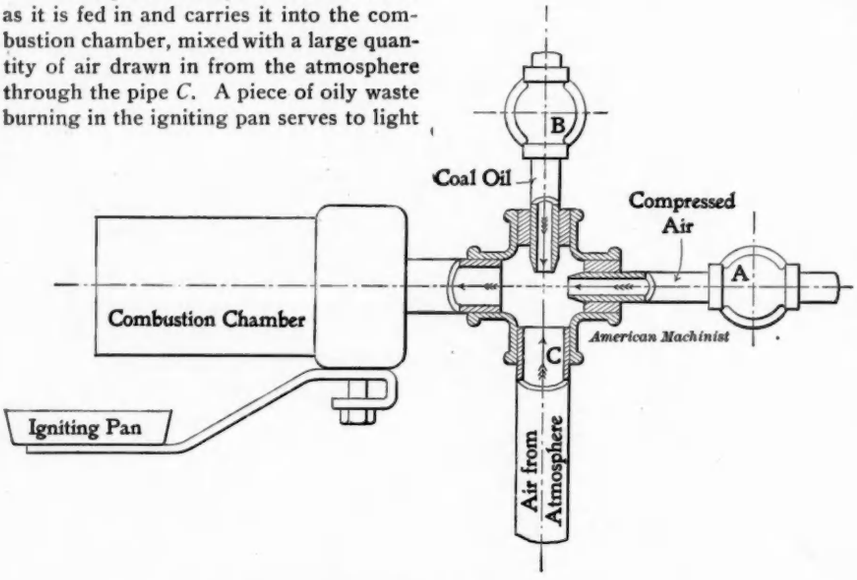
A Compressed-Air Oil Burner for the Shop.

Editor American Machinist:

The accompanying sketch is of an oil burner operated by compressed air, homely and cheaply made, which the writer has found very useful to have around. It is made of ordinary pipe and fittings, and its "modus operandi" can be readily understood from the sketch, with the assistance of a few explanatory sentences.

The ordinary coal oil used as fuel is supplied by gravity from an elevated tank, it and the compressed air being brought to the burner through hose connections, and their relative supply controlled by the valves *A* and *B*, placed in the pipes as shown.

The compressed-air jet atomizes the oil as it is fed in and carries it into the combustion chamber, mixed with a large quantity of air drawn in from the atmosphere through the pipe *C*. A piece of oily waste burning in the igniting pan serves to light



A COMPRESSED-AIR OIL BURNER.

the mixture of oil and air, after which the pan can be swung around out of the way.

By properly regulating the supply of oil and compressed air, perfect combustion and an intense heat can be obtained, the correct proportions being indicated by a blue flame and absence of smoke.

This device has been used for heating crank disks of engines for shrinking them on shafts, for shrinking in crank pins, melting babbitt out of old engine bearings, burning paint and oil off from machinery preparatory to overhauling, and for heating castings and forgings sufficiently to draw the temper of taps or drills broken off in them. Almost any machine shop fortunate enough to possess an air compressor, it seems, would find numerous uses for such a device, which any man around the shop could fit up in a few hours. The compressed air and the oil pipes are ¼ inch, and the other pipes ¾ inch.

W. L. MIGGETT.

Ann Arbor, Mich.

"The Making of Chips."

Editor American Machinist:

Mr. Tecumseh Swift may be all right when he says that the tensile strength is the same all through a piece of steel—"the same at a depth of a hundredth of an inch, where a thin chip would be severed, as at an eighth of an inch, where a thick chip would be severed"; but he will never see the day when he will find it as easy to cut a thick chip as a thin one. The rolling away of the chip, I suppose, has a good deal to do with it, but it is as much in the rolling of the chip during the act of severing the metal as it is in the rolling after it is severed, if not more so. I suppose that, as the thick chip rolls necessarily with a longer curve than the thin one, there are actually a great many more fibers being severed at once in that case than with the thin chip rolling on a shorter radius, and that is what makes the difference in the power required. Here in the two sketches there seem to be more than double the number of fibers letting go at the same time with the thick chip than with the thin one. We know in a general way something about the relations of high speeds and light cuts compared with slow speeds and heavy cuts, but the relations of power, speed and actual accomplishment in the removal of metal will bear still more investigation.

MORRIS FULTON.

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Antiquity of Paper Friction Pulleys.

Editor American Machinist:

I was much interested in the article by W. F. M. Goss, which appeared in your issue of January 28th. In speaking of the use of paper for friction pulleys, he says that "it is a new material which has recently appeared." That statement would be correct if he means that something that happened twenty or twenty-five years ago is recent. Paper friction pulleys have been very generally used in large numbers in sawmills and shingle mills for more than twenty years, and some of them have transmitted considerably more than 100 horse-power.

WM. MERRILL.

Saginaw, Mich.

[Professor Goss evidently referred to a specific material or preparation of paper used for this purpose, as being new.—Ed.]

▲ ▲ ▲

Duplex Pump Valve Gear.

Editor American Machinist:

In your issue of November 26, 1896, was reproduced from "Engineering" "a diagram showing in plan what appears to be a real improvement on the standard construction of duplex pumps." It may interest some of your readers to know that there are several United States patents covering this so-called improvement, and that the original patent will expire in 1900. I have copies of five United States patents, each one covering a special arrangement of levers, links and rods, whereby each steam piston of a duplex pump or engine controls its own slide valve to line and line of admission, the travel across the port to wide open being accomplished by connections with the lever of the opposite piston rod. The Waterhouse Fire Engine Company, of St. Paul, in 1890 and 1891 put out a number of fire engines using a duplex pump with valve gearing, designed and built under patents granted to the late H. F. Gaskill in 1887 and in 1889. There appears to be nothing new in the device referred to, except, possibly, the specific arrangement of the horizontal lever for moving the valve, which, I think, would hardly meet the approval of pump manufacturers this side of the Atlantic.

H. LANSING PERRINE.

Milwaukee, Wis.

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One Million Shapes for a Diamond-Point Lathe Tool—How to Designate Them.

Editor American Machinist:

Say that we have a shaft on the lathe centers, and that we want to take off a good heavy cut; how shall we describe the tool that we use in the operation, so that there shall be no mistake or misunderstanding about its shape or position in any particular? It should be a simple enough job to do this; and yet if it has ever been done, I do not know when or where or by whom; and as such simple things as this seem to be rather in my line, I am tempted to try my hand at this one.

Say, then, that we have a shaft *A*, Fig. 1, turning it to the size *B* at a single cut; what is the shape and setting of the tool, and how may these particulars be indicated for different conditions of material, speed, feed, lubrication, etc.?

By way of illustration, I would begin

with a tool that could not possibly work; a good way to begin, because a change could not make it worse, and any departure might be in the direction of improvement. In Figs. 2, 3, and 4, which are, respectively, front elevation, end elevation and plan, we assume the cube *C* to be the cutting tool. The cube is placed with its top side level and at the same hight as the axis of the shaft, one vertical face lying close against the turned portion of the shaft and parallel with the axis, and the left-hand vertical face, Figs. 2 and 4, of course at right angles to the axis of the shaft. These three faces of the cube are all that we have to do with in our attempt to use the cube as a cutting tool, and it will be convenient to have a distinctive name for each face. The top face, then, we will call the cutting face; the vertical face, which, at the beginning, is at right angles to the axis, we call the advance clearance face; and the other vertical face, parallel with the axis, we call the after clearance face.

These faces all meet and terminate at a common point. Three lines radiating from the same point determine the inclination or direction of the three faces; two lines of the three for each face. The lines *a* and *o* bound the cutting face, *o* and *x* the advance clearance face, and *a* and *x* the after clearance face. Each of these lines, remaining fixed at one end at the point 1, Figs. 5, 6 and 7, may be swung in two directions, vertically and horizontally, and any change in either direction will change the pitch or inclination of the face or faces which that line helps to bound. The line *a* may be changed vertically in the direction 1—2, or horizontally in the direction 1—3. The line *o* may be changed horizontally in the direction 1—4, or vertically in the direction 1—5 or 1—6, while the line *x* may be changed in the directions 1—7 and 1—8. We have thus six directions, or, in fact, seven directions, in which the three bounding lines of the solid angle of the cutting tool may be changed, each change having its effect upon the cutting ability or the satisfactory action of the tool.

If we allow for each line a possible range of 10 degrees, which is not very much (See Fig. 11), and if we assume the changes to be in steps of one degree each, or ten possible different positions for each line in each direction, we have then, with the six directions in which the lines may be moved, and the ten possible steps of movement, each change of direction making a different combination of the whole, or actually a different shape for the tool—a total number of possible combinations of $10^6 = 1{,}000{,}000$; one million shapes for the tool. This number is reached without in the least straining the possibilities of the case. The line *a*, 1—2, may be moved vertically, and in actual practice is moved, much more than 10 degrees for the different materials worked, and for the individual ideas of the worker. The line *o*, 1—4, is moved horizontally for different work and for different ideas in the workman, at least 45 degrees. Then another item in the combination comes in when the vertical corner of the tool, at the line *x*, is rounded, as it usually is, more or less. If we allow different radii for this corner, that makes another factor in the combination, so that a million is a very conservative estimate of the number of possible shapes for the tool.

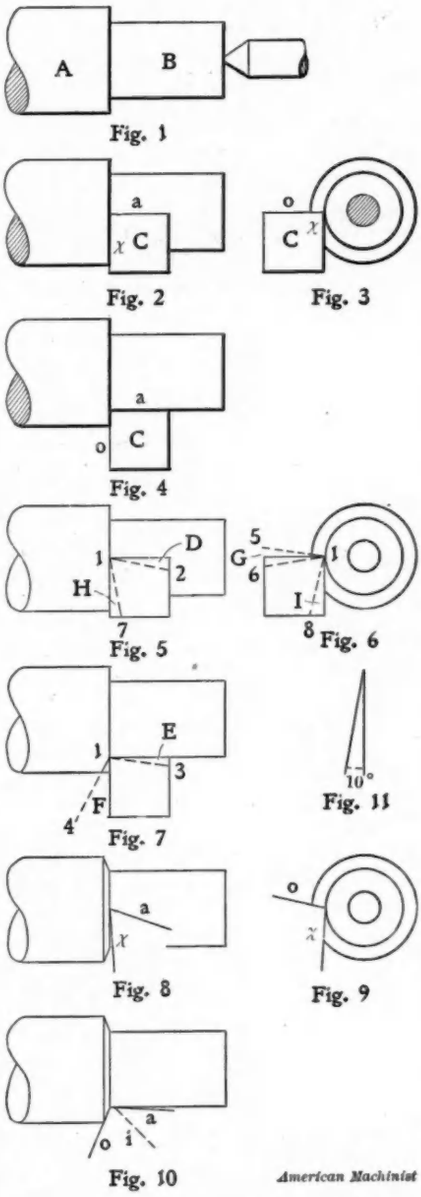

Fig. 1 Fig. 2 Fig. 3 Fig. 4 Fig. 5 Fig. 6 Fig. 11 Fig. 7 Fig. 8 Fig. 9 Fig. 10

American Machinist

ONE MILLION SHAPES FOR A DIAMOND POINT.

Saying nothing about the rounding of the corner of the tool, the shape of the entire cutting part of it may be indicated by the simple lines *a*, *o* and *x*, shown in Figs. 8, 9 and 10, the lines as there drawn being my idea of a shape suitable for turning nice soft steel. It may be proper to remark that I, of course, am talking only of the lines actually involved in the determination of the actual cutting part of the tool. The lines are not necessarily all of the same length, as in the original cube, and indeed it is quite certain that they will not be of equal length. Thus the line *a* in Fig. 10 usually is very short, and then beyond that it goes off, most likely, in the direction of the dotted line *i*. This is done usually to make the cutting part of the tool easier to grind when worn.

The vertical movement of the line *a*, indicated by the dotted line 1—2, may also be designated by the letter *D*. The horizontal movement of the same line, 1—3, may be designated by the letter *E*, and so on, the six different angular movements or possible changes employing the six letters, *D*, *E*, *F*, *G*, *H* and *I*.

We now get in a position where the value or extent of the angular movement of departure from the normal lines of the cube may be designated numerically. The absolutely horizontal, vertical or rectangular lines of the cube may in each case be designated by zero, *o*, and then if we allow nine steps of change of direction for each line in each direction, it becomes a simple matter to use a formula comprising six successive numerals for indicating the shape of the tool. The first figure would be for the vertical change *D*, the second figure would be for the horizontal change *E*, and so on. The extremes of angular change in either direction would be indicated by 9, and the possible combinations would include everything from 000000 to 999999, inclusive, which would make 1,000,000. The first combination would, of course, indicate the corner of the perfect cube in normal position, and the last combination would indicate the greatest permissible deviation from the normal lines. The numerals used might indicate one degree of change of angle for each unit in the numeral, except in the cases of *D* and *F* where this would not give sufficient range. For *D*, each unit might be assumed to indicate 2 degrees of angular movement; and for *F*, it would be necessary to give a value of 4 degrees to each unit. The first numeral at the left would then, with the above assigned values, indicate the angle *D*; the second numeral, the angle *E*, and so on. In the case of *G*, to which the fourth figure would belong, it would be assumed to be in the direction 1—5; but if, instead of that, the direction 1—6 were intended, it might be indicated by a line drawn under the figure. Now, if in the use of this scheme we should give the formula for a certain tool, as 928332, it would mean: $D = 18$ degrees from horizontal; $E = 2$ degrees from parallel; $F = 32$ degrees horizontally from a perpendicular to the axis; $G = 3$ degrees from horizontal; $H = 3$ degrees from vertical in direction (at starting) parallel with the axis, and $I = 2$ degrees from vertical in the direction at right angles to the axis. If the corner of the tool were rounded, the radius of the arc might follow the numerals, and it might then be like this: 928332 — .05. A

record of tool shapes might be kept in some such way as this, giving the actual angles:

D	*E*	*F*	*G*	*H*	*I*	*R*	Kind of Work.
18 0	2 4	32 30	3 0	3 10	2 10	1/8 0	Steel. Brass.

It is assumed all along that the three faces of the tool are perfectly flat. If any face is curved, as the advance clearance face often is, and, as I think, always improperly, that of course gives a great many more possible shapes for the tool; but I do not wish to handle them here, as I think for the present we ought to be satisfied with one million.

It is assumed all through, also, that the point of the tool remains at the same hight as the axis of the shaft. If, as is the common practice, the point of the tool is used above the center, then a radial line from the point of the tool to the axis must be taken as the line of departure, instead of the horizontal line assumed. From this radial line and its perpendiculars, the angles of the tool may be indicated, as well as from the normal level and vertical lines.

I have not here attempted in any way to indicate what shape of diamond point might be best for any particular purpose, or under any defined set of conditions. I have only suggested a scheme for accurately describing and recording the shape of the cutting point of the tool, as a means of promoting intelligent and profitable experiment and discussion.

TECUMSEH SWIFT.

▲ ▲ ▲

Jig for Drilling Tranverse Holes Through Collars.

Editor American Machinist:

Having drilled a round rod with a series of central transverse holes, and wishing to secure a number of sleeves or collars on the same, the jig illustrated in Figs. 1, 2 and 3 can be made cheaply and will be found very reliable.

In the figures, let *a* be the collar to be drilled, and *b* a round piece drilled centrally as before described. Place *b* in a block *e*, as shown, having drilled the dowel pin holes *i i* and the jig hole *g* in *c*, and *h* in *d*. Then put a close-fitting pin in *g*, *f* and *h*, and clamp *c* and *d* onto *e* while dowel-pin holes *i i* and screw holes *k k* are drilled. A close-fitting rod *b* is then driven into *e* and pinned, when the hole *f* is drilled through *a* and *b*, drilling from *g* into *a* and *b* on one side, and from *h* on the other, meeting in the center of *f* After this, the pieces *a* can be drilled clear through without turning the jig over.

The fork *m* is for holding the collars *a* up to *c*, for getting the holes all one distance from the shoulder on *a*, the sides of *b* at *n n*, Fig. 2, being milled off for a neck.

Collars like these, with the rod shown previously, were used by the writer as a shaft, with wheels for time recorders, and hubs holding the same. The wheels had figures on their rims, which had to line up in a row; and the hubs drilled in this way were opposite the shaft holes *f* when revolved to either side.

A. H. CLEAVES.

Chicago, Ill.

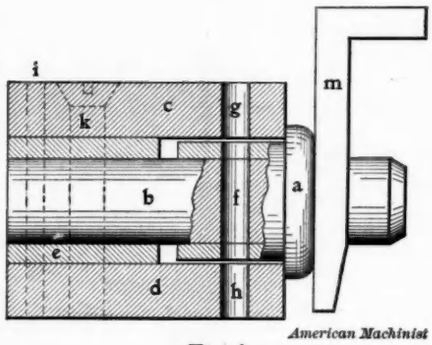

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Fig. 1

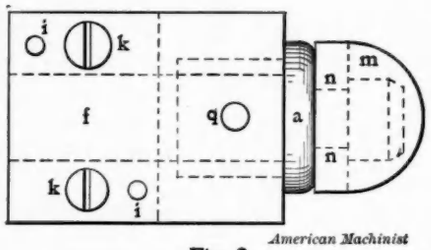

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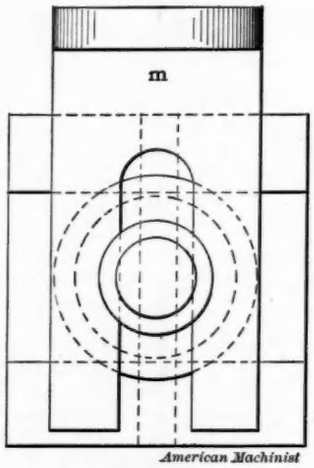
Fig. 2



American Machinist

Fig. 3

JIG FOR DRILLING COLLARS.

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The latest equipped power houses of the cable roads have generally adopted the rope drive instead of gears, and with most satisfactory results. A few days ago, however, a rope parted in the power house of the Third avenue road, in this city, and snarled things up rather badly, blocking the road and stopping traffic for a half an hour or more—an almost unprecedented delay in this locality.

Proposed Extension of the Use of Compressed Air on Men-of-War.

BY F. W. BARTLETT, P. A. ENGR., U. S. N.

Compressed air is now used for certain purposes on men-of-war, as, for charging torpedoes; in combination with water for elevating guns and running them out; for turning turrets; for steering engines, and for ash hoists.

It seems possible and feasible to extend this use, and the object of this article is to suggest some other ways of using air and to state why air is better for many purposes than either steam or electricity.

Air of various degrees of compression may be used for nearly all purposes on board ship, except for the main engines and possibly the dynamos. It could be used for running the dynamos as well, and it is only a question with these whether the economic loss would be balanced by the gains in efficiency, comfort, etc.

It is to be borne well in mind that one of the most serious troubles to be contended with on board men-of-war of modern types is the suffering due to heat and lack of proper ventilation, the debilitation and discomforts in summer being excessive in cool latitudes and overpowering in hot ones.

An attempt will be made to describe a theoretical arrangement showing the proposed changes, using air in place of steam where possible, economy being perhaps sacrificed for the sake of making life bearable in hot weather on men-of-war, and in order to have the officers and crew in condition to put forth their best efforts when called upon in emergencies.

THEORETICAL ARRANGEMENT FOR THE USE OF AIR MORE EXTENSIVELY.

As near the middle of the length of the ship as possible, preferably between sets of boilers, so that the most direct and shortest steam pipe may lead to the plant, no matter which boiler may be in use, there is an auxiliary plant room, where is located every auxiliary machine in the ship that can be placed there, so that a machinist and oiler on watch may be able to take care of them all, and not have six or eight men on watch in detached parts of the ship. Here are placed, the two auxiliary condensers; three evaporators and distillers; heating and ventilating machine; fire-room blowers; ice machine; dynamos; duplicate air compressors and reservoirs for the pressures required, as described later. These are all operated by steam for the sake of economy, as they all run with constancy when once started.

Besides the steam pipes for the main engines and this short auxiliary pipe for the central plant, the only steam pipes in the ship are those very small ones leading to the galley and pantries. This lessens materially the trouble due to heat, it being confined to a small portion of the length of the ship in port, and to only about a third at sea. The exhaust pipes

are all in the central plant room and are short, the auxiliary condensers being close at hand. Thus the heat from this pipe is also in one compartment only. Another important gain here is in the fact that there is at all times a high vacuum in the condensers, all the leakages being in this one room and easily cared for, instead of there being many detached steam-using machines all over the ship, run by all sorts of persons, many of them not knowing enough to close exhaust valves and drains when through running a machine, and others not caring to take the trouble even if they know enough.

Aside from the traps for the main engines, there are only six traps in the ship—one from each evaporator, one for the auxiliary steam pipe, one from the galley pipe and one for the pantry pipe. All of these six traps are in the central plant room, and are accessible and readily kept in good order. The discharges from these traps all go into the auxiliary exhaust pipe, as the loss of heat is small, and not important, compared with keeping the ship bearable in hot weather. This prevents also the constant discharge of vapor from the escape pipe. The discharge pipes from the traps for the main engines are led into the main feed tanks in the engine rooms, and all the pipes lead to near the bottom of the tanks, so that as much of the vapor as possible may be condensed. It was not considered advisable to lead the drains from the main engine traps to the auxiliary exhaust pipe in the distant central plant room, as too much heat would be disseminated on the way.

The discharges from the auxiliary condensers lead to a tank in the same room, this tank being connected with the main feed tanks by a pipe, the water flowing, by gravity, from the higher tank in the central plant room, a non-return valve preventing vapor from returning from the main tanks.

Thus the steam used in the ship, and the consequent heating, is only for the main engines and the central plant room, and the functions of the steam are reduced to a minimum, as far as the number of machines operated is concerned.

Of course, the air compressors are of considerable power and the pressure accumulators large, to allow for emergencies. These latter, however, occupy the upper part of the room, and are as concentrated as possible. The room is kept cool by its special ventilation, so that the temperature of the air in the accumulators is never much over that of the water outside of the ship, which is used in cooling the air. The specially designed pressure regulators for the accumulators allow of a large surplus of air ready for any sudden call, so that the air compressors may fill all the chambers full when little air is being used.

Besides the special compressors for the high pressure needed for the torpedoes, of which there are two, as now provided on our large ships, there are duplicate compressors and reservoirs, or accumulators, that keep up a constant pressure of 60 pounds per square inch. This pressure is kept constant by the action of the pressure regulators of the reservoirs acting on the throttle of the compressor, and the mechanism is found efficient for all emergencies, the pressure never dropping over 5 pounds at any time, and that only when a crane and anchor engine happen to be suddenly put in use at the same instant. At such times, however, warning is given, so that the steam stop valve outside the throttle of the air compressor engine may be opened wider, to allow for the sudden addition of such great quantities of work. Signals have previously been sent to the central plant room, to open air to the pipes for these machines, as explained below. In getting under way, and at drills when the turrets are likely to be used suddenly, both of the compressors are in operation to insure greater steadiness of pressure, but ordinarily one is amply sufficient for all needs.

In easy reach of the two attendants are valves plainly marked on the air pipes leading to each machine outside of the central plant room. Each of these machines has its own pipe, so that a large machine opening from a pipe may not throw out a smaller one, as happens with the steam pipes ordinarily in use. By this means, absolute uniformity of air pressure is secured for each machine, the sizes of pipes to each being calculated for the work to be done. At a signal from any part of the ship, the air is turned on and the machine is ready for use at once. The throttle valve at the machine is the only valve that the attendant in the distant part of the ship needs to touch. Having no exhaust valve and no drains to attend to, the operator has a simple operation to perform, only oiling the machine. After use, closing the throttle valve secures the machine. No harm is done if a signal be not sent to the central plant room when finished with the machine, so that the valve may be closed there, as a possible slight leak of air is the only trouble that can ensue. The pipe is left filled with air at the full pressure, and this air is always ready to do its work. No vacuum is destroyed by ignorance or carelessness. No return exhaust pipe is required, one small pipe carrying the power, the exhaust being into the atmosphere. The air to be used is drawn down from the ventilators, and passes around and among pipes filled with running water, so that a portion of the moisture in the air is condensed and trapped off. There are also separators where needed for removing the moisture from the air after it is compressed. The temperature of the air may be readily varied to any degree not below that of the sea water, by reducing or increasing the quantity of the circulating water, regulating the temperature of the discharge water and of the air compressed. By opening and closing the large exhaust ventilating doors at the top of the central plant room, the air in the accumulators may be kept at the temperature of the atmosphere, or as much higher as desired.

The engines in the different parts of the ship are all of the same type, but of three different sizes, thus making parts interchangeable and doing away with the carrying of many spare parts. The pipes to these machines are also of three sizes. Where a great power is required, as for turrets or anchor engine, two of the largest sizes of machines are attached to one shaft. The machines are small, three-cylinder simple, long stroke, light and fast running, the air expanding just enough to prevent the formation of ice at the exhaust nozzles, the pressure at discharge being slightly above the atmospheric pressure. At the exhaust openings there are mufflers constructed of a non-resonant substance, thus preventing much noise. These engines are geared down for the work they have to do, thus enabling the three sizes of machines to handle all the various kinds and quantities of work to be done in the ship.

This system does away with the enormous prices paid for special machines all over the ship.

The following list shows the uses to which air is put on board:

To operate: Main engine auxiliaries; auxiliary, fire, bilge and water service pumps; steering engine; anchor engine; boat cranes; winches; turret-turning engines; hydraulic cylinders for working guns; ammunition hoists; ash hydropneumatic hoists; feed pumps; smoke hose for guns; whistle and siren.

Other uses: To send messages; to clear a compartment of water when flooded; to ventilate; to heat and cool the ship.

▲ ▲ ▲

The wide circulation of the "fake" report of the sale of the Sleepy Eye rotary engine has already had effect in poking up "inventors" to abnormal activity all over the country. The rotary engine fellows have, of course, been hit the hardest. We hear from a little town in Iowa that a stock company has been formed to patent and manufacture an engine "somewhat similar to, but an improvement over, the Brambel engine." And no doubt there are others. Patent solicitors also assure us that would-be patentees generally have become unusually active of late under the stimulus of the "new journalism."

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In connection with the celebration of the twenty-fifth anniversary of Stevens Institute of Technology, it is proposed to have an exhibition of work of the institute's graduates, consisting of models, photographs and working machines. This exhibition will be open to the public on the 19th inst., at the institute, Hoboken, N. J.

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Arts Lost or Buried?

Sometimes there is a breaking-out of lamentation over the "lost arts." It is possible that there are some lost arts, but mostly they are not lost, but dead and buried. The lost arts of the machine shop are mainly of this character. We have complaints continually of the difficulty of getting good men, but the men that are wanted are men skilled and trained in the new arts, rather than the experts of the old. Some lament the loss of the skill of the old-time chippers and filers: but in that line what is there really to regret? If we could have the old vise hands at the benches as thick as they could stick all around the shop, we would have no use for them. We would have to discharge them, and they would have to learn new trades, or do worse.

This is not only so with the men of the shop and their manual skill, but it is true also of the tools of the shop. Who realizes what a change has come over the status of the file in the shop? Files are still made and used in large quantities, but relatively they have lost much of their old-time responsibility. For the average work of the average shop, or, say, for nine-tenths of all the work of all the shops, we are absolutely independent of the file for the truth and accuracy of the work, where at one time we were as absolutely dependent upon it. Files, by the way, were the first of all the tools of the machinist to be made for him by outsiders as a business, and for long years they were the only tool so made.

The chipping chisel, which may have antedated and outranked the file, is to-day considerably below it in importance. For the numbers of men now employed in any machine shop, certainly not one-tenth the number of chisels would be found that would have flourished at a time within the memory of men now living, and those which we now have are only for occasional or emergent use, and seldom find steady employment.

Then the hammer has fallen into desuetude along with the chisel. These two used to be associated, something as the letters "q" and "u" travel together; but the hammer has had to go it alone of late, and it oftener now hits a center punch than it does a chisel.

The center punch, too, has suffered. The old way of turning up work on centers made with a center punch, would now be considered a barbarism. That other practice of locating holes to be drilled by this means, and the scribing of the circumferences of the holes all around with, usually, eight or a dozen center-punch marks to make sure of them, is almost obsolete.

We may well wonder whether the day may not come when some antiquary will have a collection of old rusty files in his museum, with a hammer and chisel and center punch as a full sample kit of tools of one of the workers in one of the lost arts.

In the meantime that other barbarity, the monkey wrench, holds its own.

▲ ▲ ▲

Cast Iron Prejudice.

The day seems to be past when cast iron is to be considered always and necessarily the inferior metal simply because the cheapest. It is not now, at least in the casting, the cheapest metal, so that the temptation to use it in improper places has largely disappeared, and it has a better chance to find employment upon its merits. We have seen many cast-iron connecting rods for steam engines, some upon tugboat engines, and we have seen a 48-inch lathe with cast iron for the main spindle. The day of these things is gone forever, but the same day saw the cast-iron crosshead pin in almost universal use, and it would be hardly safe to say that anything has yet been found better adapted for that service. Those pins used to stand the wear remarkably well. Although cast solid with the crosshead, and therefore not renewable, they would often last for many years. At the present time we happen to know of a line of machinery in which is used a steel crosshead pin, a straight pin held at both ends with the connecting rod working on the portion of the pin between. The pin wears quite rapidly in spite of all the care that may be exercised. It is seriously proposed to put in a cast-iron pin instead of the steel one. It would certainly wear much better than the steel, and it would be sufficiently strong, so that there would not be the least probability of its breaking; but the machine builder still hesitates to adopt the cast iron, fearing that it will injure the sale of the machine, and that he will be said to be using inferior material in construction. There are other places where cast iron as a wearing surface might be profitably adopted, but where it is not used on account of this still surviving prejudice. We have not yet heard of any of our big steel shafts being coated with shells of cast iron at the journals, and we, of course, are not rash enough to suggest it; but if anyone has the hardihood to try it, we will not be surprised at his success and satisfaction. We at least hope and expect that cast iron will survive all prejudices.

▲ ▲ ▲

It is stated that the collision which took place at a railroad crossing near Bridgeton, N. J., last summer has already cost the companies concerned in it nearly a million dollars, and is likely to cost them still more. It is worth noting that this amount of money would pay for a great deal of the most improved modern apparatus for preventing such collisions, and it is more than likely that the officers of these roads would long ago have adopted and put into use such apparatus if they had been allowed to follow the dictates of their own judgment. The most discouraging feature of such cases is the fact that officers of railroads usually feel the necessity of so managing things as to maintain dividends or increase them as may be dictated from Wall street, and that there is little or no opportunity for the exercise of that good business judgment which would indicate that a present large expenditure which might reduce dividends for the present year would in the end be amply justified by the prevention of such expensive accidents or by the increase of dividends to be paid in the future. There is no doubt whatever that if the officers operating railroads could have their own way in such matters the roads would be much better equipped, both as regards accident-preventing appliances and in other respects than now, or can be under the present system of management; and it is perhaps this fact which, as much as any other, gives force to the contention that railroads, which of a ne-

cessity perform a public function, should be, more than they are now, under the control of the public or its representatives.

▲ ▲ ▲

Great results seem to be expected in some quarters from the recent heavy reductions in the price of steel rails following the disruption of the "steel rail pool" and it seems reasonable to suppose that the general effect will be more or less beneficial. Those who think that high prices and "advancing markets" are always and necessarily unmixed good, should be expected to predict disaster to general business from this decline; but in our sober senses we all know that whether high and higher prices are a good thing or not depends upon what the cause of the higher prices may be, what it is that is held at a high price, and into whose coffers the profits go. Steel rails are a necessity of our modern life and form of civilization, and their price has been for a long time kept at an abnormal figure for the sole benefit of a few individuals. That in this case at least, the main object of the combination was not to "effect economies of production, and thus sell the product at or below competitive prices, without loss to the producers," is shown by the fact that competition immediately reduced prices when given an opportunity to become operative. For a time, at least, we shall no longer behold the interesting spectacle of foreigners buying American steel rails at considerably lower prices than American railroads can buy them for, and it seems evident that the general stimulus given to business by the very large orders given for rails as soon as the lower prices were quoted will have a good effect upon business generally; aside from the fact that it would now seem possible for many roads to keep their track in good order, and yet have money enough left to be able to buy some other things—machine tools, electric machinery, locomotives and cars, for instance.

▲ ▲ ▲

Chief Engineer William S. Smith, United States Navy, who for three years had been stationed in Philadelphia, as a member of the Naval Examining Board, died on the 7th inst. He was born in Baltimore, enlisted in the navy at the outbreak of the Civil War, and was Third Assistant Engineer on board the "Colorado," North Atlantic squadron. Subsequently he served in the "New Ironsides," the "Powhatan," the "Yantic," the "Nipsic" during its service on the Darien expedition, and on the "Monocacy" in the Asiatic fleet; at the Navy Yard at Washington, during which service in 1875 he was promoted to be Chief Engineer; in the "Ossipee" and the "Kearsarge," and at San Francisco, where he superintended the construction of the "Charleston." Then he was assigned to the "Marion" and the "Lancaster."

Business is, for some reason, unusually brisk at Watervliet Arsenal at present, and on the 8th inst. they commenced working "double turn" with two gangs of men on all the large machines; which it is thus designed to keep at work 16 hours per day. The day men begin work at 7 A. M. and work till 4 P. M., at which time the night gang commences and works until 12 P. M.

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Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(16) W. S. H., Detroit, Mich., asks for details of the process of galvanizing iron. A.—The process is a simple one. The surface to be coated is first subjected to a thorough cleansing by immersion in a bath containing one or two per cent. of sulphuric acid, after which it is well washed in clean water and then dipped in a vessel of melted zinc, the surface of which is kept covered with sal-ammoniac to dissolve the oxide constantly forming on the surface of the zinc.

(17) H. C. W. asks: Suppose a man to stand on a pair of scales in an elevator at the top of a high building, and the elevator begins to descend at a uniform rate of twenty feet per second. When the falling man catches up to the descending elevator, will the scales immediately register his full weight, or more or less, or when would he regain his original weight? A.—If the elevator were really to begin to descend at twenty feet velocity (a thing which, in point of fact, it could not do), it would leave the man behind it in the air, as gravity acting on his body could only impart this velocity after a lapse of time. At the end of this lapse, the man and the elevator would be traveling downward at the same speed, but the man still in the air falling freely. His velocity would continue to increase, and he would finally overtake the elevator. At the moment of impact he would be traveling faster than the elevator, and the scales would register more than his true weight. Under actual conditions, the elevator and the man gain their velocity together, and the true weight would be shown as soon as both reach a uniform speed, whatever that may be.

(18) A. T. D. asks: 1, Is it practicable to bore a 6-inch cylinder 12 feet long with a boring bar 2 15-16 inches diameter with traveling head? A.—We think it could not be well done in a horizontal position, but if placed vertical it might be done. Use four cutters and have the cutting faces square with the bar, so that in cutting they would not have any side thrust. But why not revolve the pipe in a long lathe and use a half-round bit, as described in our issue of January 14th, for boring the big guns? The bit need not be so expensively made as those that Uncle Sam uses. 2, Is it practicable to bore 4-inch cylinders 12 feet long with the same style of boring and traveling head, only smaller? A.—This seems to be covered by our answer to the previous question, only that with the smaller diameter the horizontal boring with the half-round or *D* bit would be still more to be preferred. 3, How much will an engine lift under the following conditions? The engine is rated 4 or 5 horse-power and runs at 600 revolutions per minute. On the shaft is a pinion of 13 teeth driving a wheel of 54 teeth, and on the same shaft with this wheel is a 13-tooth pinion working into another wheel of 54 teeth upon the drum shaft. The drum is 12 inches diameter and carries a wire rope 5/8 inch diameter, which does the lifting. The gears are cast. How much should be allowed for friction? A.—The nominal size of an engine is practically worthless as a basis for computation. We should in all cases have the cylinder diameter and the working pressure, besides all the particulars given above. Assuming that the engine is actually 4 horse-power, that would mean $33{,}000 \times 4 = 132{,}000$ foot-pounds per minute. The revolutions of the drum would be $(600 \times 13 \times 13) \div (54 \times 54) = 35$ per minute, nearly. Then, the rope diameter being 5/8 inch, the drum diameter to the center of the rope would be 12 5/8 inches, and the hoisting speed would be $12.625 \times 3.14 \times 35 \div 12 = 115.6$ feet per minute. Then $132{,}000 \div 115.6 = 1{,}141$ pounds. We would allow one-half for friction and for uncertainty of data. Then, $1{,}141 \div 2 = 570$ pounds, the probable lift. Even less than this might be realized, as the high engine speed seems rather suspicious.

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The New York Cycle Show.

What is thought by many to be probably the last National Cycle Show that will be held in this country for some time, closed last week in this city. In a general way, and as a spectacle, it may be said to have been a very great success; the brilliantly illuminated Grand Central Palace, filled with finely decorated booths and "spaces," making a very attractive scene.

Mechanically, the show contained very few startling novelties, and it is evident that the wheel can now safely be said to have been fully evolved, so far as its general features are concerned. The weights of last year—somewhat greater than those of the year before—are fully maintained and the efforts of inventors and improvers seem to have been mainly in the direction of making the wheel a more serviceable machine for those who use it as a vehicle of business or of recreation, rather than as a racing machine.

NEW FEATURES.

The main points of difference between the '96 and '97 models may be said to be in the latter's "flush joints" (which, however, are by no means universal, some of the best makers retaining the older forms), in a somewhat lower crank-hanger and in larger sprockets. In the matter of this latter feature, we might, if we were disposed to follow the example of some of our contemporary daily journals, claim some glory for having pointed out, long before the present movement towards larger sprockets began, that sprocket wheels had been reduced to mechanically objectionably small diameters; the idea seeming to have been too prevalent that anything was permissible, and even necessary, if it only resulted in the one thing—reduction of weight.

GEARED WHEELS.

Three geared wheels were shown. One of them, called the "Bayvelgear," is not

entirely new, having been on the market several years. Another was shown by Spaulding Bros., and is similar to the other in its general features, inasmuch as both use four bevel gears to transmit the motion from crank-shaft to rear wheel; the longitudinal shaft passing through the lower right-hand member of the frame, the gears are, in both instances, entirely covered and protected from dust and mud.

The third geared wheel had what is called the "Gentry Gear." This is not a bicycle, but an attachment to be put into any wheel in place of the ordinary sprockets and chain. A spur gear about 8 pitch, $\frac{5}{16}$ inch face, is put in place of the large sprocket, and a pinion of the same pitch and face replaces the small sprocket on the rear wheel. Connecting these two is a train of seven intermediate spur wheels, about 2½ inches diameter, same pitch and face. These latter run on fixed studs having ball tracks, and all the gears are of steel, hardened. Where the distance between crank-shaft and rear axle is short, the case containing the intermediate gears may be entirely below the driver and driven gears, if necessary; and when the distance is greater, the case is simply raised to secure proper meshing—the extreme limit in this direction being where the centers of all the gears are in one straight line. Of course, innumerable possible objections to this device will suggest themselves to the practical mind; but the exhibited attachment worked well, and the exhibitor of it declared that the favorable reception it had met had led to the decision to go ahead and manufacture them for the market.

One other wheel was shown which was partially geared. It was the "$10,000 Elgin" tandem—a beautiful piece of gold-decorated and bejeweled mechanism, having its forward and rear crank-shafts connected by a longitudinal shaft, driven and driving by helical instead of by bevel gears. This brings the shaft directly under the center of the frame, and, in service, the gears are covered. The usual chain is used at the rear.

A NARROW TREAD DEVICE.

Among the other novelties is one which illustrates the probable extreme limit in the direction of narrow tread. The crank-shaft bearing in this machine has but one ball race, which is placed in the center of the frame, the crank-shaft hanger being no longer than the diameter of the frame tubing. To compensate for decreased length, the diameter is greatly increased, the ball track being about 4 inches diameter, so that the moment of the force exerted upon the balls is probably not greater than in the ordinary construction.

TWO SPEEDS.

A number of two-speed devices are shown, among them one called the "Brown-Lipe," which seems to be mechanically excellent, as might be expected from the fact that the late Mr. C. E. Lipe, of Syracuse—well known to many of our readers—had much to do with its origination.

UGLY SPROCKET WHEELS.

A feature of many of the wheels shown, which strikes a mechanic rather unpleasantly, are the fancy patterns of sprocket wheels used. There are many of these which are monstrous, mechanically, and to the trained mechanical eye nothing looks nearly so well as the plain straight arms, which conform to what has been found best for the arms of gear wheels and pulleys in other machines. A webbed gear wheel, with holes drilled through the web in more or less regular order, would in these days be ridiculed as a monstrosity in machine construction. It is difficult to see why it is any more appropriate for a bicycle sprocket wheel; and those made up of scroll patterns, etc., are simply abominable.

MINOR CHANGES.

Though the general form of most wheels remains unchanged, there are numberless improvements in details of bearings, methods of adjustment, etc., one notable instance of this being in the case of the Hamilton-Kenwood, whose mechanical man, H. W. Parkhurst, is an occasional contributor to our columns. His improvements in the wheel mentioned are covered by something like eighteen new patents, and include arrangements by which adjustments of bearings are not disturbed by removing wheels from frames; and in so arranging bearings that all the balls come out with the spindle and are retained in place with it, so that inspection and cleaning, without risk of displacement or loss, is an easy matter.

ELECTRIC LAMPS.

Among accessories, electric lamps are perhaps the most prominent novelties. One of these shown, called the "Acme," has a four-cell dry battery, each cell being good for three hours' lighting by a miniature incandescent lamp placed in the focus of a reflector. The batteries are cheap, and are intended to be replaced when exhausted.

Another lamp, called the "Lumino," is similar, except that it is operated by a small storage battery, which runs eight hours and can be charged from any incandescent lamp circuit, or from a primary battery. This lamp can be deflected and its rays sent in any desired direction by the rider, and neither of the lamps can be blown or jarred out; nor do they spill oil, or take fire, or smoke.

A RUSTLESS METAL.

A new thing which, if it bears out all the claims made for it, will be of importance to others besides cycle manufacturers, is called "Carbondale Metal," specimens of it being shown by the United States Cycle Fittings Company. This is a metal resembling steel in most respects, and attaining a tensile strength of 168,000 pounds per square inch, but is non-oxidizable; a specimen sheet being shown, which was suspended so as to be covered by sea water at every high tide, for some months, without the least appearance of corrosion resulting. Spokes were shown made of it, and looked like steel, nickel-plated. They are fully guaranteed.

MACHINE TOOLS.

In the basement of the building were a few exhibitors of machine tools, most of whom were vigorously "kicking" about the poor facilities afforded for accomplishing the purpose for which they came. Very few people went to the basement, and very few inducements were offered for them to do so.

A line of chucks, specially adapted to cycle manufacturing operations, was shown in one space; and Mr. Buel, of the Builders' Iron Foundry, explained the points of superiority in their line of grinding machinery, countershafts, etc., all of which are more or less familiar to our readers. In the Niles Tool Works' space were some tools, most of which we have illustrated; and the Ferracute people showed some presses specially adapted to chain-making and other cycle manufacturing operations. Most of the machine tools shown were belted for operation.

On one of the upper floors, the Pratt & Whitney Company showed some of their small tools; and the Garvin Machine Company had a space in which they had simply a desk and chairs—place in which to transact business.

SALESMEN'S TALK.

One of the entertaining features of such an exhibition is to be credited to the fact that salesmen, rather than mechanics, are employed to talk to visitors about the wheels shown. Most of these salesmen are, of course, well-meaning enough and intend to give correct information, but their knowledge of the points they are discussing is usually very superficial, and some of them may properly be said to "impart to the truth an undue degree of elasticity."

One of these chaps, talking to a man whom he evidently thought knew as little as he himself did about mechanical matters, was explaining the superiority of his ball cups over any others, and he said, without the blink of an eye and with the air of a man who deliberately intended to be moderate in his statements: "You see this cup looks much like others, but it costs us about a dollar to produce it; whereas the ordinary cup commonly used costs, perhaps, three cents. Mere polish is nothing, but our curves are just precisely right. To make that cup involves twelve operations, two of which are on

an engine lathe, and three on an American Watch Tool Company's bench lathe."

This wheel had S curved cranks "for looks," and not to gain power, as was claimed to be the effect of a curved crank on another wheel.

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The Hebrew Technical Institute.

On Lincoln's birthday, February 12th, the new building of the Hebrew Technical Institute of the city, which has been completed and occupied for several months, was formally dedicated with appropriate exercises. The building is of gray stone and light brick, five stories high with basement, and fireproof. The shops, classrooms and laboratories occupy the upper floors. The students are instructed in elementary knowledge and work. The average age of entrance is twelve and a half years, and the graduates at about sixteen are fitted to engage in some kind of practical work. The institution has been in operation a number of years. Last year thirty-four graduated, and all found employment averaging $5 per week. Sixty-nine per cent. of all graduates are known to be now in lucrative employment in mechanical or drafting work.

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In our issue of January 21st we published an extended review of Engineer Frank M. Bennet's book, "The Steam Navy of the United States," omitting to give the name of the publishers. In attempting to correct this omission, we misnamed the title of Mr. Bennet's book, and gave instead the title of an older book, written by Frank M. Dennet. With our readers' kind permission, we will now attempt to make a correct statement as follows: Mr. Frank M. Bennet, Passed Assistant Engineer, United States Navy, wrote the book reviewed in our issue of January 21st, and the book is published by Warren & Co., 416 Wood street, Pittsburg, Pa.

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The United States Torpedo Boat No. 6, officially tested on February 10th, developed a speed of 28.78 knots, or 33.14 statute miles per hour. The guaranteed speed was 28 knots.

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Commercial Review.

NEW YORK, SATURDAY EVENING, FEB. 13TH.

RAILS RUN WILD.

The great commercial news item of the hour is the smash-up of the steel rail pool. Only a few weeks ago the association marked the price down from $28 to $25 per ton, and now the figures have fallen, without its help, so low that sales are reported to have been made on a basis of $17, Chicago delivery. Free-for-all prices have so appealed to the hearts of the railroads that a tonnage of 500,000, 600,000, or perhaps more, already has found a market, the magnitude of which sales may be appreciated if it be noted that the production during 1896 amounted only to 800,000 tons, including street car rails as well as those for steam roads.

In spite of the appalling effect that all this must have upon certain interests in the iron market there are those who believe it to be a precursor of benfit to business generally. To those who argue that a renewed activity in mill operations at such unprofitable figures will do no good, it may be replied that what trade and industry need more than anything else is, to be set in motion, and that then they will take care of themselves.

MILL AND MACHINISTS' SUPPLIES.

The long night of waiting for a reillumination of trade has not yet broken. The reports from the local houses with whom we communicate as a basis for our statements, give reports which average very nearly as they did a month ago. Those of improvement are offset by others less favorable. The matter is not entirely inconsistent with a slight increase in demand, but if there be such it has not spread over the market.

Prices are weak in tone. They have hitherto been upon such an extremely low basis that it would not be correct to say that the past month has shown much actual change. However, we are given to understand that the rates on certain lines have been still further liberalized to insiders. The collapse of the bolt trust and consequent demoralization of the discount list are public matters.

Wood pulleys enjoy the distinction of having advanced about 25 per cent. within two or three months past. This has been due rather to the legal complications in regard to them than to an increased demand, although one of the companies prominent in their manufacture reports, as a result partly of the litigation and partly of the public desire for them, an improving trade. The betterment, they think, is a decided one in Connecticut and appreciable in Massachusetts, while in Pennsylvania dullness rules.

TARIFF TALK.

Clearly, it would seem that the supply market cannot assume any great degree of activity until the lines of industry upon which it is dependent begin to move. The event which people are now fond of pointing out as a bugbear, to be gotten out of the way before business is free to revive, is the anticipated tariff revision. We confess a difficulty in understanding why business men should hesitate in carrying out their plans on that account; for since the change is going to be an increase in rates, one would be on the safe side of the matter if he contracted upon the present basis, and an addition to the duties, even if of no practical benefit, would amount merely to surplusage of security as far as he is concerned.

THE BICYCLE EXHIBITION.

Another market factor of present interest is the bicycle show held in this city during the week just closing. This is far less a subject to enthuse over commercially than it was last year. People will naturally be cautions after the lesson of the slump in the spring of '96. But now that the cycle show has been held, it would seem that we should look for more demand for tools and machinery supplies to be used in bicycle manufacture. We learned in connection with the supply market this week, that as yet the bicycle factories are not buying freely. A report, which may or may not

(Continued on page 36.)

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Business Specials.

Transient Advertisements 40 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear wheels, gear cutting. Grant; see page 16.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Engine Castings ⅛ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Send $1 to the Tabor Mfg. Co., Elizabeth, N. J., for improved stop-motion revolution counter.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Duplex and special gear cutters, counterbores, cutter and surface grinders, vertical millers, hand punches and shears. R. M. Clough, New Haven, Ct.

The American Ball-Bearing Co., of Cleveland, have exceptionally good facilities for the manufacture of bicycle cups and cones; tempering, case hardening and grinding are a specialty with them.

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Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday Morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted.

Wanted—Position as brass f'ndry foreman; thoroughly experienced. Address BOX 66, AM. MACH.

Wanted—Pos. as draftsman by tech. man; 3 yrs. exp.; good refs. if wanted. Box 61, AM. MACHINIST.

Compt. draftsman wants position; exp. in designing engs., boilers, gen'l machy. E. P., AM. MACH.

Foundry Foreman, has considerable experience, is open for position. BOX 72, AMER. MACHINIST.

Sit. abroad, good mach. designer, auto. tools, etc. Ref. past and pres. emp.; age 26. BOX 77, AM. MACH.

Wanted—A position by foreman boiler maker—a hustler. A1 references. BOX 83, AMER. MACHINIST.

Practical molder wants job. Heavy engine, general jobbing, ship work, in loam, dry, or green sand. Reference A1. Address BOX 82, AM. MACH.

Wanted—Position as foreman of machine shop by a man of experience and thoroughly up to date; A1 reference. BOX 84, AMERICAN MACHINIST.

A first-class general machinist wishes a position where sobriety and attention to business will be appreciated. Can take charge of shop or erect work outside; 25 years' experience. Address BOX 75, care AMERICAN MACHINIST.

A1 mech. eng., tech. grad., with extensive mach. shop and foundry experience, quick, accurate designer, up-to-date in shop methods and handling men, wishes any position where energy and ability count. BOX 73, AMERICAN MACHINIST.

Wanted—Change of position—12 years experience as machinist, tool maker, draftsman and superintendent. Now in charge of a prominent dividend paying shop; age 30. Good ref. as to character and ability. Address BOX 85, AM. MACH.

(Continued from page 35.)

be general in its application, was heard at the show, to the effect that orders for the wheels themselves which should be placed at about this time are not coming in as they ought to do. So, upon the whole, the machinery and supply interests had better not stake their all upon the bicycle shop trade.

THE EXPORT SIDE OF TRADE.

Mr. W. D. Hill, manager of the New York office of the Saginaw Manufacturing Company, who make the Gilbert wood pulleys, was traveling in Great Britain last year. While there he devoted enough time to business to appreciate the great industrial revival there in progress and to test the attitude of the people to the wood pulley. He says that they have not yet gotten educated up to that article as compared with the iron one. A shop owner remarked to him of some of the latter: "Those pulleys up there were used by my grandfather." "But," said Mr. Hill, "suppose that some day you should wish to make improvements and should try wooden ones?" "If the iron ones were good enough for my grandfather," was the reply, "they are good enough for me." Mr. Hill believes that although the Europeans are slow about welcoming an innovation, they are critical judges of the value of a thing; that it is useless to try to palm off inferior goods upon them; and that when once an article is introduced it rapidly grows popular. He says that one way in which American goods find an introduction is through men who have come to this country to engage in business and then form the purpose of returning to their own lands to sell wares made here.

Upon the invitation of the Philadelphia Museum, a party of more than forty delegates from the chambers of commerce of Spanish-American cities is expected to make a business tour in this country during June and July next. They will visit our factories and determine our capability of meeting their requirements.

Fifteen locomotives were this week shipped to Japan by the Burnham, Parry, Williams Company, of Philadelphia, and forty-four more follow in another steamer. They are said to be the heaviest yet shipped.

Our summation of items of machinery distinguishable in the daily reports of cargoes foreign bound from the port of New York, made public during the week ending February 13th, gives about $355,000.

Quotations.

NEW YORK, Monday, February 15th.

Iron—American pig, tidewater delivery:	
No. 1 foundry, Northern	$12 00 @ $12 50
No. 2 foundry, Northern	11 50 @ 11 75
No. 2 plain, Northern	10 75 @ 11 00
Gray Forge	10 50 @ 11 00
No. 1 foundry, Southern	11 50 @ 12 00
No. 2 foundry, Southern	10 75 @ 11 00
No. 3 foundry, Southern	10 25 @ 10 75
No. 1 soft, Southern	10 75 @ 11 00
No. 2 soft, Southern	10 50 @ 10 75
Foundry forge, or No. 4 Southern	10 25 @ 10 50

(Continued on page 37.)

Wanted—By a practical mechanical engineer and designer a position, either as superintendent of shop, or as engineer of plant; have been 5 years in present position; can give best of reference. Box 81, AMERICAN MACHINIST

Wanted—Position by a thorough practical mechanic, A 1 machinist and draftsman, well posted in designing and getting up general and special machinery for all purposes, high speed steam and gas engine. Box 68, AMERICAN MACHINIST.

Position wanted by designer, draftsman and expert mech. now in charge of shop building elec. hyd. and belt power elevators. Would be pleased to cor. with parties in this business or desirous of engaging in same. Up to date, care AMER. MACH.

A skilled designer and constructor with 25 years' exp. in labor saving and auto. mach. is open for engagement, or will undertake spec. work for mfrs. Unquestionable references from past and present employers and patrons. Ad. Box 71, AM. MACH.

Energetic tech. grad., several years exp. in office mach. shop, d'ftsman, stenog., typewriter & bookkeeper desires pos. as asst. to M. E., or in office of manufacturing concern. Steady, reliable. Best reference. Address Box 79, AMERICAN MACHINIST.

Pattern maker, age 37, at present working in the South, has held charge of shops in the North, desires position to take charge of pattern shop; experienced in all around pattern work; can show references, but don't believe in them. Address Box 80, AMERICAN MACHINIST.

Wanted—Pos. as supt. or gen. foreman of mach. shop, by energetic, up-to date man of good address. Tech. grad., 13 yrs. prac. exp. in estimating cost of mach. and handling men; strictly first class; not afraid to place himself on trial. Reference if desired. Address Box 78, AMERICAN MACHINIST.

Address Box 86 AMERICAN MACHINIST if you want a man who has served time as machinist, draftsman and supt., age 30, experi'd in designing and building steam, elec. and gen'l mach'y and tools. At pres. supt. of a large and prosperous shop. Good reason for changing. Ref. as to abil. and integrity.

Wanted—A position in a bicycle mfg. or any mfg. concern where they want a designer of tools and mach. Can make estimates of entire cost of bicycles from rough to finish. Had 10 yrs. exp. at same, also estimates on tools and fixtures. Can design bicycle. Have some new ideas, not freaks, as flush as strong as outside joint, & at no more expense. Have held every pos. from supt. down, also d'ftsman. Can handle drop ham'rs, screw mach., millers & edgers. Temp., married, age 33 years. Box 76, AM. MACH.

Help Wanted.

Help Wanted—Good pay for leisure hours. Geo. W. Lord, Philadelphia, Pa.

Wanted—Good lathe and planer hand; state exp. and wages expected. Ad. Box 392, Danbury, Conn.

Wanted—An exp. and reliable tool maker. State age, exp., former employer and wages expected. Williamsport Staple Co., Williamsport, Pa.

Detail draftsman wanted. Must have had 1 or 2 years actual experience and be sober, reliable and willing to accept position in a small country town. Address "Country," care AMERICAN MACHINIST.

Wanted—An experienced draftsman on steam pumping machinery, one who is familiar with the latest designs of direct-acting steam pumps of duplex type, including compound and triple expansion. Address Box 74, AMERICAN MACHINIST.

Wanted—An experienced pattern maker to take charge of pattern shop in architectural iron works; must be thoroughly familiar with stair work and all kinds of ornamental iron work. Address James McKinney & Son, 925 933 Broadway, Albany, N. Y.

Wanted—Two first-class machinists on general jobbing and special machinery; men that are not afraid of work, and capable of taking charge of outside jobs, erecting, etc. State experience, age, size, and wages expected. Address A. M. W., care AMERICAN MACHINIST.

Wanted—A first-class designer of modern light machine tools; position open abroad in a large manufacturing establishment; no applications can be considered except from thoroughly capable men; suitable salary will be paid. Reply, giving full details as to qualifications, to box 56, AMERICAN MACHINIST.

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Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d h'd lathes & planers. S.M. York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Special machinery for manuf. of cycle chain. Full particulars. Garfitt & Son., Sheffield, Eng.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., of Spring and Varick streets, New York City.

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

For Sale—Several Pratt & Whitney and other machine tools at 40 per cent. off cost. Have been in use a few months only. Send for list to T. K. Webster, 1075 W. 15th Street, Chicago.

Wanted—An Idea. Who can think of some simple thing to patent? Protect your ideas; they may bring you wealth. Write John Wedderburn & Co., Patent Attorneys, Washington, D. C., for their $1,800 prize offered to inventors.

For Sale—Blakeslee Bolt Header, size C, heads 5/8 to 2 1/2 inch bolts; 40 lb. Bradley Rubber Cushion Helve Hammer; No. 4 Emerson Power Scale. Practically good as new machines. Address H. T. Marshall Machine Co., Brockton, Mass.

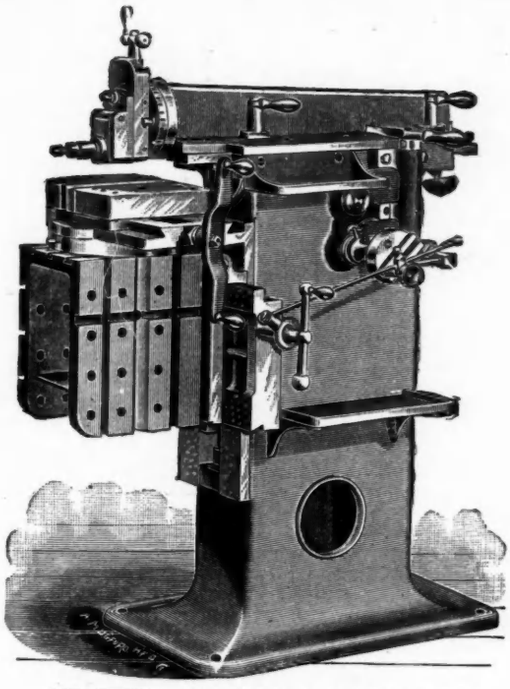
J. M. ALLEN, President.
WM. B. FRANKLIN, Vice-President.
F. B. ALLEN, Second Vice-President.
J. B. PIERCE, Secretary and Treasurer.

Columbia University
in the City of New York.

SCHOOL OF MINES,
SCHOOL OF CHEMISTRY,
SCHOOL OF ENGINEERING,
SCHOOL OF ARCHITECTURE,
SCHOOL OF PURE SCIENCE.

Four years' undergraduate courses and special facilities for graduate work in all departments. Circulars forwarded on application to the Secretary of the University.

SHAPERS
SHAPERS
FITCHBURG MACHINE WORKS
FITCHBURG, MASS., U.S.A.
METAL-WORKING MACHINERY.
CATALOG E.
SHAPERS
SHAPERS



..IMPROVED..

15-inch Hendey Shaper.

Latest Improvements.
Useful Attachments.
Strong and Powerful.

...FOR...

Die Work, Tool Room or General Shop Work.

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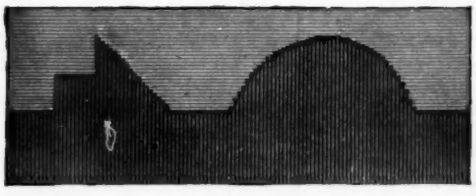
The stroke can be adjusted for curves with machine in motion. The stroke can be adjusted for angles with machine in motion. The stroke can be adjusted for irregular work with machine in motion. It has adjustable table for planing taper work; table can be removed for fastening work to apron. Has a strong graduated swivel vise. Quick work, rapid changes, modern ideas.



This cut shows how stroke can be adjusted with machine in motion by micrometer; adjustment fine and delicate. SEND FOR CIRCULAR.

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THE HENDEY MACHINE CO.

TORRINGTON, CONN.

Agents for the Pacific Coast—PACIFIC TOOL AND SUPPLY COMPANY, San Francisco, Cal.

European Agents, { CHAS. CHURCHILL & CO., London and Birmingham. SCHUCHARDT & SCHÜTTE, Berlin and Vienna. EUGEN SOLLER, Basel, Switzerland.

(*Continued from page 36.*)

Bar Iron—Base—Mill price, in carloads, on dock; common, 1.10 @ 1.15c.; refined, 1.15 @ 1.25c. Store prices: common, 1.35 @ 1.45c.: refined, 1.40 @ 1.60c.

Tool Steel—Ordinary sizes, standard quality, 6 @ 7c., with some brands perhaps a little less; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—Ordinary brands, from store, 1.60 @ 1.65c.

Cold Rolled Steel Shafting—Base size, 2.60 @ 2.65c., from store.

Copper—Carload lots, Lake Superior ingot, 12 00c.; electrolytic, 11⅝ @ 11¾c.; casting copper, 11½ @ 11⅝c.

Pig Tin—For 5 and 10-ton lots, 13.50 @ 13.65c., f. o. b.

Pig Lead—In carload lots, 3.25 @ 3.30c., f. o. b.

Spelter—In carload lots, New York delivery. 4.10 @ 4.15c., f. o. b. and upward.

Antimony—Cookson's, 7¼ @ 7½c.; Hallett's, 6¾ @ 7c

Lard Oil—Prime city, present make, commercial quality, in wholesale lots 38 @ 40c.

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Manufactures.

At Essex, Mass., Mr. Isaac Gates is erecting a new saw-mill.

The Riverside Iron Company, Wheeling, W. Va., will erect a new mill.

At Dallas, Pa., Capt. Bond will erect a machine shop and foundry.

At Waverly, Mass., the Boston Bridge Company will erect a large building.

D. H. Gato, Jacksonville, Fla., is going to erect a new factory at that place.

At Kansas City, Mo., the Dredging & Machinery Company has been incorporated.

Messrs. Mann & Sprague, of Orange, Mass., are erecting an addition to their plant.

Mr. A. E. Shurtleff, of Lewiston, Me., contemplates the erection of a flouring mill.

William Nice, Jr., Philadelphia, Pa., will make an addition to his wood-working mill.

The Keystone Gas Engine Company will erect extensive works at New Brighton, Pa.

The Shoenberger Steel Company, Pittsburg, Pa., will erect a building for manufacturing purposes.

A stone-crushing plant will be erected by the Chicago & Naperville Stone Company, Chicago, Ill.

At Pittsburg, Pa., the Kepp Gear Wheel & Foundry Company's plant was destroyed by fire recently.

Stone, Fuller & Co., of Cleveland, O., contemplate the erection of a cement factory at Bronson, Mich.

The saw-mill of the Jones Lumber Company, Williamsburg, Ky., was recently destroyed by fire.

At Carlisle, Pa., J. H. Hughes and J. W. Place, of New York, contemplate the erection of a new silk mill.

Will W. Daviess & Co., Louisville, Mo., have secured a large manufactory, which, it is said, will be erected at once.

At C. Hanika & Son's Iron Company, Muncie, Ind., have commenced the construction of an addition to their works.

The iron foundry of George Smith, Jersey City, N. J., and the machinery was very much damaged by fire recently.

The Firth-Sterling Steel Company, McKeesport, Pa., are to rebuild the machine shops recently destroyed by fire.

Mr. Charles Herwig will open a tinsmith shop at Pottsville, Pa., which will be equipped with the most improved machinery.

At Henderson, Ky., Mr. J. D. Williford will erect a flouring mill. It is estimated that $20,000 will be expended on the plant.

At McMinnville, Tenn., the foundry and machine shops belonging to Thomas H. Eastwood were recently destroyed by fire.

The Gilson Asphaltum Company is contemplating the erection of a plant at Kansas City, Mo. New grinding machinery will be installed.

It now seems certain that the coach and car shops of the Missouri, Kansas & Texas Rail-